NELLCOR

OxiMax®
N-65

Handheld Pulse Oximeter
Service Manual

Nellcor Puritan Bennett Incorporated is an affiliate of Tyco Healthcare. *Nellcor, Oxiband, Durasensor, OxiCliq, Dura-Y, MAX-FAST*, and *OxiMax* are trademarks of Nellcor Puritan Bennett Incorporated or an affiliate.

Cet appareil ISM est conforme à la norme NMB-001 Canada.

To obtain information about a warranty, if any, contact Nellcor's Technical Services Department, or your local representative.

Purchase of this instrument confers no express or implied license under any Nellcor Puritan Bennett patent to use the instrument with any sensor that is not manufactured or licensed by Nellcor Puritan Bennett.

Covered by one or more of the following U.S. Patents and foreign equivalents: 4,802,486; 4,869,254; 4,928,692; 4,934,372; 4,960,126; 5,078,136; 5,485,847; 5,743,263; 5,865,736; 6,035,223; 6,298,252; 6,463,310; 6,591,123; 6,675,031; 6,708,049; 6,801,797; and Re.35,122.

Contents

Introduction 1

Warnings 1
Cautions 2
Notes 2
Manual Overview 3
Description of *OXIMAX* N-65 4
Front Panel Description 4
Front Panel Symbols 8
Rear Panel Symbols 8
Label Symbols 9
Menu Parameters 10
Set Menu Parameters 11
Set Time/Date Parameters 12
Related Documents 14

Routine Maintenance 15

Cleaning 15
Periodic Safety Checks 15
Functional Checks 15
Battery Installation 16

Performance Verification 17

Introduction 17
Equipment Needed 17
Performance Tests 17
Power-On-Self-Test 17
Discussion 17
Procedure 18
Operational Setup 22
Setting the Time and Date 22
Discussion 22
Procedure 22
General Operation 26
Operation with a Live Subject 26
Pulse Oximetry Functional Tests 28
Test Setup 31
Test 1: BPM 32
Test 2: SpO2 33
Test 3: Modulation Level 34

Test 4: Light Level 36
Safety Tests 37

Troubleshooting 39

Introduction 39
How To Use This Section 39
Who Should Perform Repairs 39
Troubleshooting Guide 39
Error Codes 42

Disassembly Guide 47

Introduction 47
Tools Required 47
Replacement Level Supported 47
Prior to Disassembly 48
Separating the Front and Back Cases 48
SpO2 PCB or User Interface PCB Replacement 50
Front Case Assembly Replacement 54
Rear Case Assembly Replacement 57
Battery Compartment Door Replacement 59

Spare Parts 61

Introduction 61
Obtaining Replacement Parts 61
Parts List and Accessories 61

Packing for Shipment 65

Introduction 65
Returning the Monitor 65
Repacking in Original Carton 65
Packing in a Different Carton 67

Specifications 69

Performance 69
Electrical 73
Environmental Conditions 74
Physical Characteristics 75
Compliance 75
Manufacturer’s Declaration 75

Technical Discussion 81

Oximetry Overview 81
Functional versus Fractional Saturation 82
Measured versus Calculated Saturation 82
OXIMAX Technology 83

Block Diagram Theory 84
SpO_2 Printed Circuit Board 85
Patient Interface 85
Power Supply 85
Power Monitoring 85
User Interface Printed Circuit Board 85
Keypad 86
Backlight 86
CPU and Flash 86
Real-Time Clock 86
Audio 86
LCD 87
IrDA 87
Power Supply 87
Power Supply Monitoring 87

Index 109

Blank Page

Introduction

Warnings

Warnings are identified by the WARNING symbol shown above.

Warnings alert the user to potential serious outcomes (death, injury, or adverse events) to the patient or user.

WARNING: The sensor uses the date and time provided by the *OXIMAX* N-65 handheld pulse oximeter when the sensor event record is recorded by the sensor. The accuracy of the date/time is dependent on the date/time already set in and provided by the monitor.

WARNING: Explosion hazard. Do not use the *OXIMAX* N-65 in the presence of flammable anesthetics mixed with air, oxygen, or nitrous oxide.

WARNING: Do not spray, pour, or spill any liquid on the *OXIMAX* N-65, its accessories, connectors, switches, or openings in the enclosure as this may damage the monitor.

WARNING: Chemicals from a broken LCD display panel are toxic when ingested. Use caution when the *OXIMAX* N-65 has a broken display panel.

WARNING: The use of accessories, sensors, and cables other than those specified may result in increased emission and/or create invalid readings of the *OXIMAX* N-65.

WARNING: Do not silence the *OXIMAX* N-65 audible alarm or decrease its volume if patient safety could be compromised.

WARNING: To ensure patient safety, do not place the monitor in any position that might cause it to fall on the patient.

WARNING: As with all medical equipment, carefully route patient cabling to reduce the possibility of patient entanglement or strangulation.

WARNING: To ensure accurate performance and prevent device failure, do not expose the monitor to extreme moisture such as rain.

Cautions

Cautions are identified by the CAUTION symbol shown above.

Cautions alert the user to exercise care necessary for the safe and effective use of the *OXIMAX* N-65.

Caution: Observe ESD (electrostatic discharge) precautions when working within the unit.

Caution: Observe ESD (electrostatic discharge) precautions when disassembling and reassembling the *OXIMAX* N-65 and when handling any of the components of the monitor.

Caution: When reassembling the *OXIMAX* N-65, tighten the screws that hold the cases together to a maximum of ten inch-pounds. Over-tightening could strip out the screw holes in the front case, rendering it unusable.

Notes

Notes are identified by the **Note** symbol shown above.

Notes provide useful helpful information.

Manual Overview

This manual contains information for service personnel who will service the Nellcor model *OxiMax* N-65 handheld pulse oximeter, herein referred to as the monitor. Only qualified service personnel should service this product. Read the operator's manual carefully and thoroughly understand the operation of the monitor.

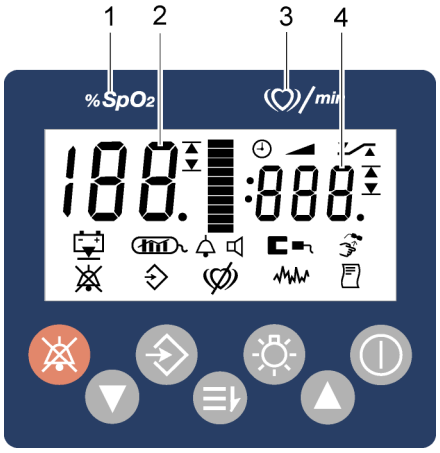
Description of *OxiMax* N-65

The *OxiMax*™ N-65 handheld pulse oximeter is indicated for continuous or spot check monitoring of functional arterial oxygen saturation (SpO_2) and pulse rate of adult, pediatric and neonatal patients in hospital, hospital-type facilities, transport and mobile environments as well as in the homecare environment.

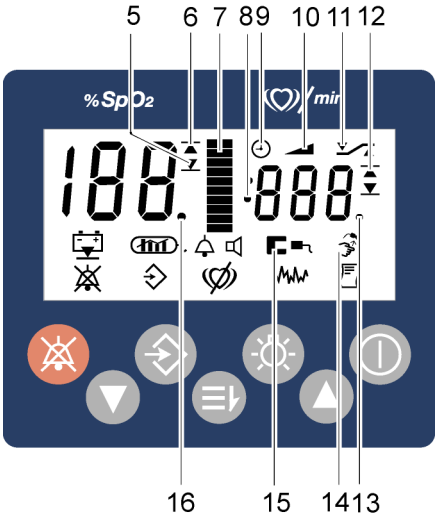
Front Panel Description

This section identifies the symbols, controls, displays, and indicators on the *OxiMax* N-65.

Refer to the *OxiMax* N-65 Operator's Manual for a complete description of all buttons, symbols, controls, displays and indicators.



1 — **%SpO2** area of display
2 — Measured %SpO2
3 — Pulse beats per minute (BPM) area of display
4 — Measured BPM



5 — **%SpO2 Lower Alarm Limit** indicator

6 — **%SpO2 Upper Alarm Limit** indicator

7 — **Pulse Amplitude** indicator (Blip bar)

8 — **Time Colon** time/date field separator

9 — **Adjust Time** mode indicator

10 — **Adjust Volume** mode indicator

11 — **Set Limit** mode indicator

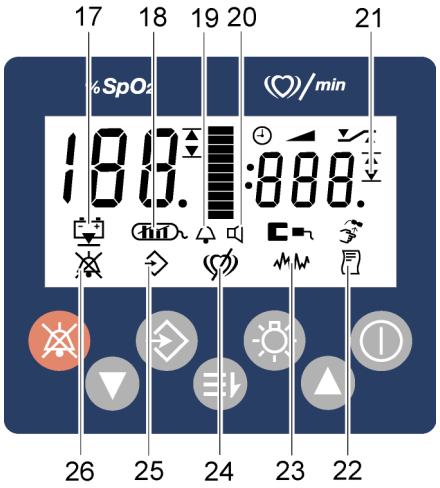
12 — **BPM Upper Alarm Limit** indicator

13 — **BPM Limit Changed** indicator

14 — **Sensor Off Patient** indicator

15 — **Sensor Disconnected** indicator

16 — **%SpO2 Limit Changed** indicator



17 — **Low Battery** indicator

18 — **Data In-Sensor** indicator

19 — **Alarm Volume Adjust** indicator

20 — **Pulse Beep Tone Volume Adjust** indicator

21 — **BPM Lower Alarm Limit** indicator

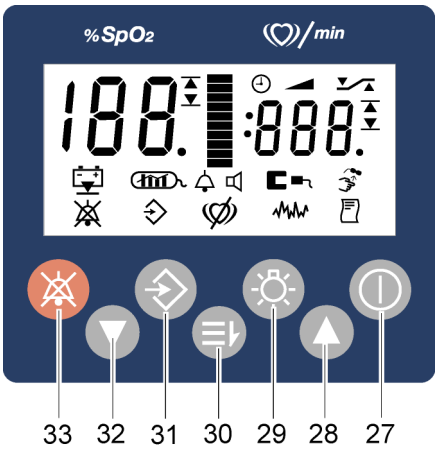
22 — **Print** indicator

23 — **Interference** indicator

24 — **Pulse Search** indicator

25 — **Data** indicator

26 — **Alarm Silenced** indicator



27 — **Power** button

28 — **Up Arrow** button

29 — **Backlight** button

30 — **Menu** button

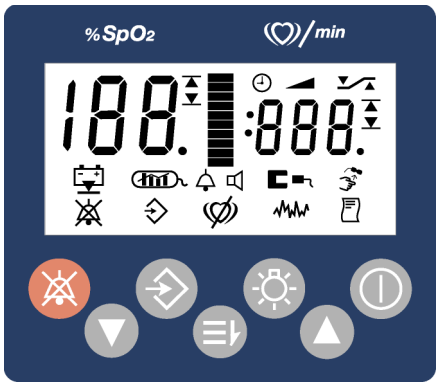
31 — **Data** (Record/Print) button

32 — **Down Arrow** button

33 — **Alarm Silence** button

Front Panel Symbols

The follow two symbols are located on the front panel of the monitor.

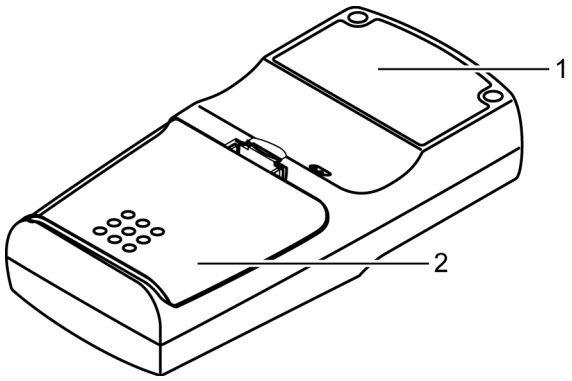


%SpO2 Displays the measured percent of oxygen saturation.

/min Displays the measured pulse beats per minute.

Rear Panel Symbols

The following symbols are located on the rear panel of the monitor.



1 — Label

2 — Battery Cover

See Instructions for Use

Type BF Applied Part - Not defibrillator proof

IPX1 Resistant to liquid ingress

Rx ONLY

Prescription only

Date of Manufacture

European union approval

Canadian/USA certification mark (electrical safety)

Russian regulatory approval

Serial number

Label Symbols

These symbols display on the monitor's labels.

Keep away from heat

Temperature limitation

Protect from moisture

Fragile

Keep upright

Humidity limitation

Menu Parameters

This section contains information on how to set monitor parameters and limits using the menu structure.

See *Set Menu Parameters* on page 11 to set the following parameters:

- high and low SpO2 limits
- high and low BPM limits
- alarm volume
- pulse beep volume
- data printing

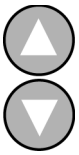
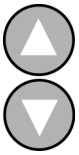
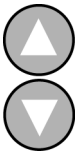
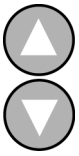
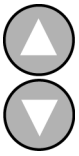
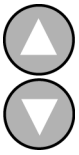
See *Set Time/Date Parameters* on page 12 to set the following parameters:

- Hour
- Minute
- Day
- Month
- Year

Set Menu Parameters

To set menu parameters, press the **Menu** button repeatedly during normal operation to display the parameters to set. Use the **Up Arrow** button or **Down Arrow** button to adjust the parameter limit. Press the **Menu** button to return to the default monitoring display.

Table 1: Menu Structure

# of Presses	Parameter	Press	Function
1	%SpO_2 Low Limit		Adjust limit
2	%SpO_2 High Limit		Adjust limit
3	BPM Low Limit		Adjust limit
4	BPM High Limit		Adjust limit
5	Pulse Beep Volume		Adjust volume. Indications on blip bar.
6	Alarm Volume		Adjust volume. Indications on blip bar.
7	Print Data		Print summary and/or stored snap-shot and sensor-event data.

WARNING: Do not silence the *OXIMAX* N-65 audible alarm, or decrease its volume, if patient safety could be compromised.

Set Time/Date Parameters

To access the Time/Date settings menu, press the **Menu** button during start-up Power-On-Self-Test (POST). Press the **Menu** button repeatedly to display the time/date parameters to set. Use the **Up Arrow** button and **Down Arrow** button to adjust time/date settings. Press the **Menu** button to return to the POST display.

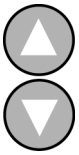
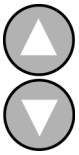
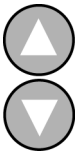
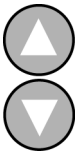
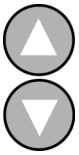
When the month entry is made, the monitor checks the day selection to see if it is valid. If the day selection is not valid for the month selected the menu display returns to the day selection display.

When the year entry is made, the monitor checks the day and month selections to see if they are valid. If the day or month selection is not valid for the year selected the menu display returns to the day selection display.

Examples of invalid dates are:

- 30 February
- 31 February
- 31 April
- 31 June
- 31 September
- 31 November
- 29 February on a non-leap year

Table 2: Time Set Menu

# of Presses	Parameter	Press	Function
The Menu button must be pressed during the POST.			
1		Hour		Adjust 1 to 23
2		Minute		Adjust 1 to 59
3		Day		Adjust 1 to 31
4		Month		Adjust 1 to 12
5		Year		Adjust 2003 to 2099

Related Documents

To perform test and troubleshooting procedures and to understand the principles of operation and circuit analysis sections of this manual, you must know how to operate the *OxiMax* N-65. Refer to the *OxiMax* N-65 Operator's Manual. To understand the various Nellcor approved *OxiMax* sensors that work with the monitor, refer to the individual *OxiMax* sensor's Directions For Use.

The latest version of the operator’s manual and the service manual are posted on the Internet at:

http://www.mallinckrodt.com/respiratory/resp/Serv_Supp/ProductManuals.html

Spare Parts and Accessories are posted on the Internet at:

http://www.mallinckrodt.com/respiratory/resp/Serv_Supp/Apartweb/main/PartAcceMenu.html

Routine Maintenance

Cleaning

WARNING: Do not spray, pour, or spill any liquid on the *OxiMax* N-65 its accessories, connectors, switches, or openings in the enclosure as this may damage the monitor.

For *surface-cleaning* and *disinfecting* follow your institution's procedures or:

- The *OxiMax* N-65 may be *surface-cleaned* by using a soft cloth dampened with either a commercial, nonabrasive cleaner or a solution of 70 percent alcohol in water, and lightly wiping the surfaces of the monitor.
- The monitor may be *disinfected* using a soft cloth saturated with a ten percent solution of chlorine bleach in tap water.

Before cleaning an SpO2 *OxiMax* sensor, read the Directions For Use enclosed with the *OxiMax* sensor. Each sensor model has cleaning instructions specific to that sensor.

Periodic Safety Checks

The *OxiMax* N-65 does not require calibration.

A qualified service technician should perform the following safety checks every 24 months.

To perform periodic safety checks:

1. Inspect the equipment for mechanical and functional damage.

2. Inspect safety labels for legibility. If the labels are damaged, contact Nellcor's Technical Services Department, 1.800.635.5267, or your local Nellcor representative.

Functional Checks

If the monitor has been visibly damaged or subjected to mechanical shock (for example, if dropped), immediately perform the performance tests. See *Performance Tests* on page 17.

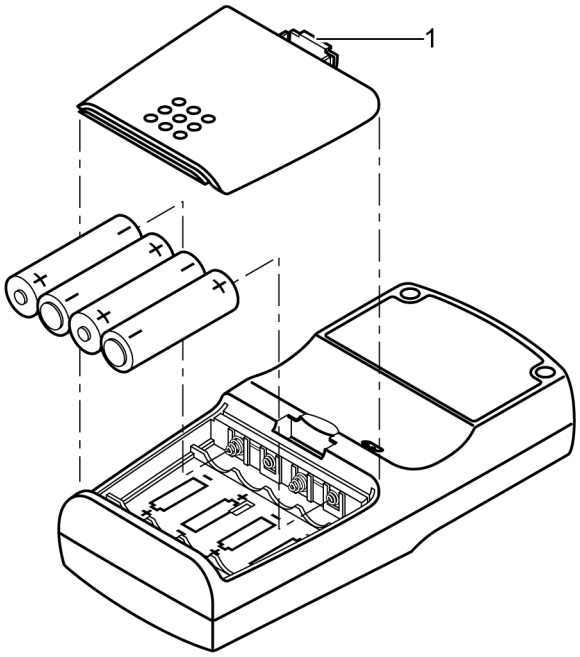
Every two years a qualified service technician should perform the electrical safety tests detailed in *Safety Tests* on page 37. If the unit fails these electrical safety tests, refer to *Troubleshooting* on page 39.

Battery Installation

Caution: The monitor does not operate with dead batteries. Install new batteries.

To install new batteries:

1. Press the **Power** button to turn the monitor off.
2. Pull the battery compartment latch downward, toward the bottom of the monitor, and remove the battery access door. See Figure 1.
3. Install four “AA” size batteries, orientated as shown in Figure 1.
4. Replace the battery access door.



1 — Battery compartment latch

Figure 1: Installing Batteries

WARNING: Explosion hazard. Do not use the *OXIMAX* N-65 in the presence of flammable anesthetics mixed with air, oxygen, or nitrous oxide.

Performance Verification

Introduction

This section discusses the tests used to verify performance following repairs or during routine maintenance. All tests can be performed without removing the *OxiMax* N-65 cover. All tests, except the battery charge and battery performance tests, must be performed as the last operation before the monitor is returned to the user.

If the monitor fails to perform as specified in any test, repairs must be made to correct the problem before the monitor is returned to the user.

Equipment Needed

Equipment	Description
Durasensor® *OxiMax* oxygen sensor	DS-100A
OxiMax oxygen sensor	MAX-A
Extension cable	DEC-4
Nellcor model SRC-MAX Tester	Provides testing for *OxiMax* compatible monitors

Performance Tests

The Power-On-Self-Test (POST) performance test verifies that the *OxiMax* N-65 is ready for patient monitoring.

Power-On-Self-Test

Discussion

Before using the monitor, you must verify that it is working properly and is safe to use. Proper working conditions are verified each time the monitor is turned on as described in the following procedure. The POST verification procedure takes approximately 10 seconds to complete.

Caution: If any indicator or display element does not light when the monitor is turned on, do not use it. Instead, contact qualified service personnel, your local Nellcor representative, or Nellcor's Technical Services Department.

Note: Physiological conditions, medical procedures, or external agents that may interfere with the monitor's ability to detect and display accurate measurements include: dysfunctional hemoglobin, arterial dyes, low perfusion, dark pigment, and externally applied coloring agents, such as nail polish, dye, or pigmented cream.

Note: The *OxiMax* N-65 automatically starts POST, which tests the monitor circuitry and functions.

Caution: During POST (immediately after power-up), confirm that all display segments and icons are shown, and the monitor speaker sounds a one-second tone.

When the monitor is turned on, the backlight remains on. The display displays the following sequence, in order, as POST takes place:

- All display graphics are shown for three seconds and the backlight is turned on.
- The display goes blank (all display elements off) for one second.
- The software version number displays for three seconds as a three digit number in the right number field (with leading zeros if the version number is less than 100) and two dashes in the left number field.
- The current time of day is shown in 24-hour format.
- Successful completion of POST is announced by a POST pass tone. A failed POST is announced by a high-priority alarm tone.

Procedure

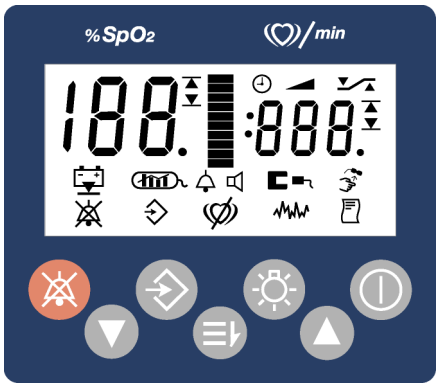
To run POST:

1. Press the **Power** button to turn on the monitor.

Note: Do not have a sensor connected to the monitor.

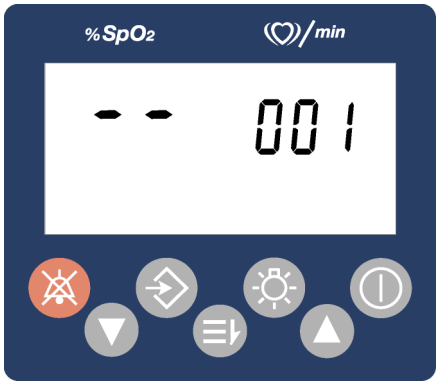
The backlight remains on during POST.

All display numbers and icons are shown for three seconds. The backlight is turned on.



2. The display goes blank for one second.

3. The software version number displays. The software version is identified by two dashes in the %SpO2 area of the display.

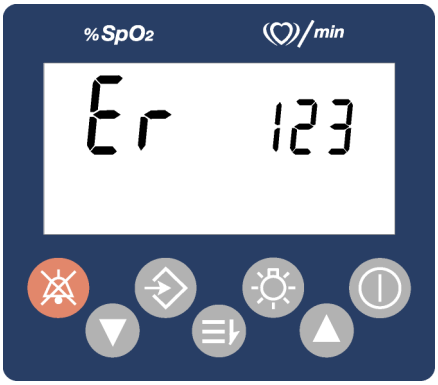


Note: The software version 001 is an example. Check the monitor for the software version installed. Write down the software version number and have it available prior to requests for technical assistance.

4. The current time displays in a 24-hour format.

Note: If the time has never been set, do not continue until you set the time. See *Operator's Manual.*

5. If the monitor detects a problem, an error tone sounds and an error code (Er) and the error number display. See *Troubleshooting* on page 39.



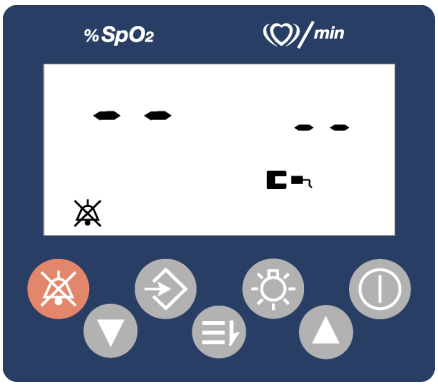
6. Upon successful completion of POST, the monitor sounds a one-second tone to indicate it has passed the test.

WARNING: If you do not hear the POST pass tone, do not use the monitor.

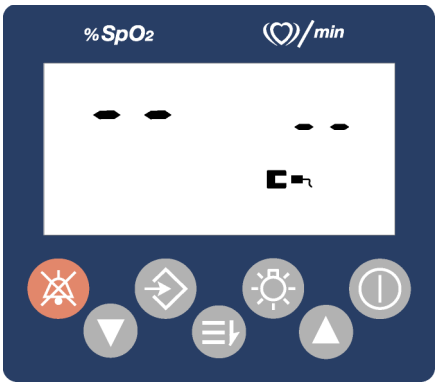
WARNING: Ensure that the speaker is clear of any obstructions and that the speaker holes are not covered. Failure to do so could result in an inaudible alarm tone.

Note: In addition to serving as the POST pass verification, the POST pass tone also functions as audible confirmation that the speaker is performing properly. If the speaker does not function, the alarm warning sounds cannot be heard.

7. Press the **Alarm Silence** button. The **Alarm Silenced** indicator displays.



8. Press the **Alarm Silence** button. The **Alarm Silenced** indicator does not display.



9. Press the **Backlight** button. The backlight turns on.

10. Press the **Backlight** button. The backlight turns off.

Operational Setup

The operational setup procedure sets the time and date into the monitor. Refer to the *OXIMAX* N-65 Operator's Manual for individual parameter settings. The monitor returns to the factory default settings when it is powered on: therefore, individual parameter settings need to be set at that time.

Setting the Time and Date

Discussion

WARNING: The *OXIMAX* sensor uses the date and time provided by the *OXIMAX* N-65 when the patient alarm events are recorded to the memory chip in the sensor. The accuracy of the date/time used for patient alarm events depends on the date/time set in the monitor.

Note: When the monitor times-out in 30 seconds, the parameter is set and the monitor display returns to the normal operation.

Normal operation means:

- the monitor is turned on
- a sensor is connected to the monitor
- the sensor is applied to the patient
- the patient's %SpO2 (oxygen saturation percentage) and pulse rate readings (BPM) are being reported
- no error conditions exist

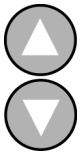
Procedure

To set the time and date:

1. With the monitor in normal operation, press the **Power** button to turn the monitor off.

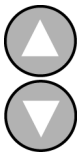
2. Press the **Power** button to turn the monitor on.

3. Press the **Menu** button during the POST operation until the set hours window appears with the hours indication (13) flashing.



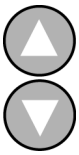
4. Press the **Up Arrow** button or the **Down Arrow** button until the desired hours appear.

5. Press the **Menu** button to set the hours and show the minutes set display. The minutes indication (45) flashes.



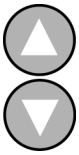
6. Press the **Up Arrow** button or the **Down Arrow** button until the desired minutes appear.

7. Press the **Menu** button to set the minutes and show the day set display. The day indication (29) flashes.



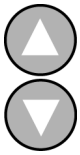
8. Press the **Up Arrow** button or the **Down Arrow** button until the desired day appears.

9. Press the **Menu** button to set the day and show the month set display. The month indication (7) flashes.



10. Press the **Up Arrow** button or the **Down Arrow** button until the desired month appears.

11. Press the **Menu** button to set the month and show the year set display. The year indication (2004) flashes.



12. Press the **Up Arrow** button or the **Down Arrow** button until the desired year appears.

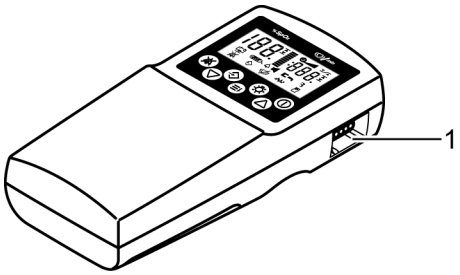
13. Press the **Menu** button to set the year and return to normal operation.

General Operation

The Operation with a Live Subject test is an overall performance check of the system.

Operation with a Live Subject

Patient monitoring involves connecting the *OxiMax* sensor to a live subject for a qualitative test.



1 — Sensor Port

To connect the *OxiMax* sensor to a live subject for a qualitative test:

1. Connect a Nellcor *OxiMax* MAX-A oxygen *OxiMax* sensor to the monitor.

2. Clip the MAX-A to the subject as recommended in the *OxiMax* sensor's Directions For Use.

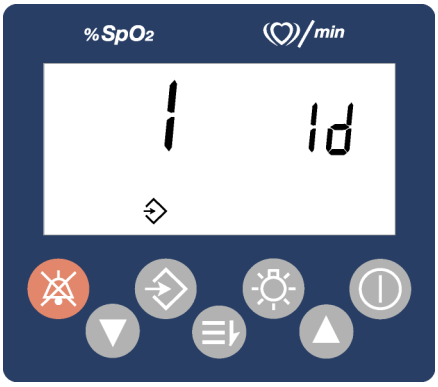
3. Press the **Power** button to turn the monitor on and verify that it is operating.

   The monitor should stabilize on the subject's physiological signal in approximately 30 seconds.

4. Verify that the oxygen saturation and pulse rate values are reasonable for the subject.

5. Press the **Data** button.

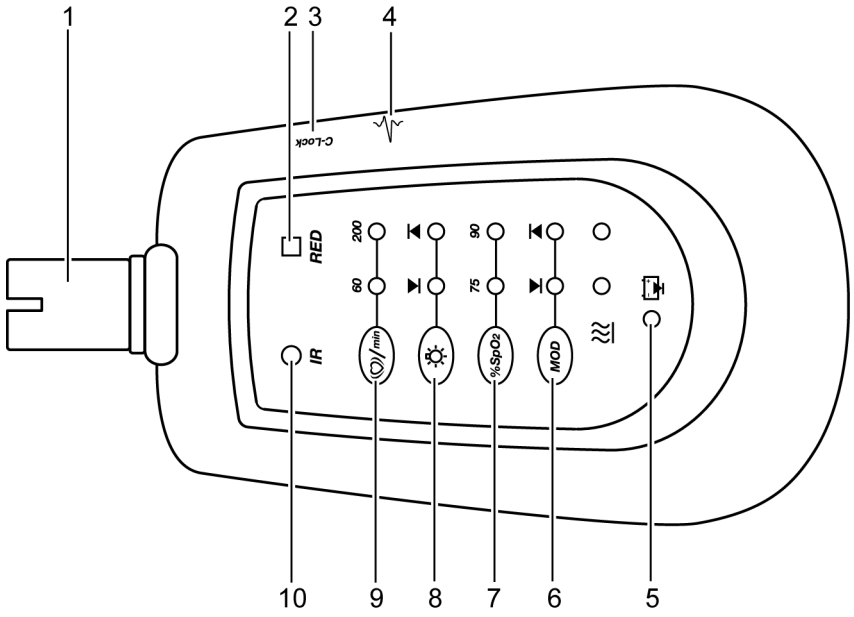
The monitor records snap-shot data.



6. Turn off the monitor.

Pulse Oximetry Functional Tests

The Pulse Oximetry Functional Tests utilize the pulse oximetry functional tester (Nellcor model SRC-MAX) to verify the performance of the monitor. See Figure 2.



1 —*OxiMax* N-65 Cable Connector	6 — % Modulation Select Button
2 — RED LED Drive Indicator	7 — % SpO_2 Select Button
3 — Not Used For *OxiMax* N-65	8 — Light Level Selection Button
4 — Not Used For *OxiMax* N-65	9 — Pulse Rate Selection Button
5 — Battery Low Indicator	10 — INFRARED LED Drive Indicator

Figure 2: SRC-MAX *OxiMax* Oximetry Tester

The SRC-MAX functional tester allows qualified technicians to functionally test Nellcor *OxiMax* technology-based pulse oximeters and OEM *OxiMax* technology-based monitors.

The Pulse Oximetry Functional tests should be completed in the order shown:

- Test Setup

Note: The technician must complete Test Setup before performing tests 1 through 4 as follows.

- Test 1: BPM
- Test 2: SpO_2
- Test 3: Modulation
- Test 4: Light

See Table 3, "Pulse Oximetry Functional Tests", on page 30 for a brief description of each test.

Table 3 shows the Pulse Oximetry Functional Tests you must perform and a description of each.

Table 3: Pulse Oximetry Functional Tests

Test	Description
Test Setup	This procedure establishes the baseline for all the other tests. Test Setup must be performed before performing any or all of the SRC-MAX tests. See *Test Setup* on page 31.
Test 1: BPM	This procedure simulates an *OXIMAX* sensor attached to a patient indicating 60 bpm and 200 bpm. The test sets up Test 1 for 60 bpm. See *Test 1: BPM* on page 32.
Test 2: SpO_2	This procedure simulates an *OXIMAX* sensor attached to a patient, indicating 75 percent blood oxygen saturation and 90 percent blood oxygen saturation. The test sets up Test 2 for 75 percent blood oxygen saturation. See *Test 2: SpO2* on page 33.
Test 3: Modulation	This procedure simulates an *OXIMAX* sensor attached to a patient indicating low and high pulse strength. The test sets up Test 3 for low pulse strength. See *Test 3: Modulation Level* on page 34.
Test 4: Light	This procedure simulates an *OXIMAX* sensor attached to a patient indicating low and high light level passing through the patient at the sensor site. The test sets up Test 4 for low light level. See *Test 4: Light Level* on page 36.

Test Setup

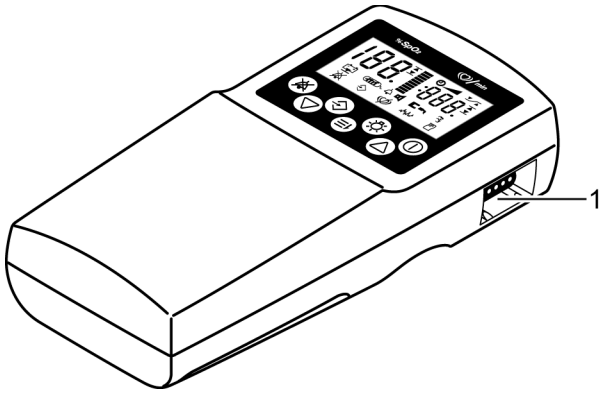
You must complete Test Setup before performing any other pulse oximetry functional tests.

To perform test setup:

1. Press the **Power** button to turn on the monitor.

2. After the monitor presents the monitoring screen, connect the SRC-MAX tester to the monitor sensor port as shown.

Note: Use a DEC-4 extension cable between the SRC-MAX and the monitor.



1 — Sensor Port

The SRC-MAX panel lights and in a few seconds the monitor tracks the simulator.

After the monitor completes POST, the monitor:

- is in SpO_2 alarm
- displays an %SpO_2 of 75 (pass criteria is 73 to 77 %SpO_2 inclusive)
- displays a pulse rate of 60 (pass criteria is 57 to 63 bpm inclusive)

- **Pulse Amplitude** indicator - displays low level modulation (low amplitude pulse amplitude indicator)

Test 1: BPM

To perform Test 1: BPM:

1. Press the SRC-MAX % **Pulse Rate** selection button.

The SRC-MAX **Pulse Rate 200** LED lights.

The monitor bpm increases to 200 and stabilize at 200 bpm. The test pass criteria is 197 to 203 bpm inclusive.

The monitor:

- displays 75 %SpO2
- displays 200 bpm (pass criteria is 197 to 203 bpm inclusive)
- alarms
- **Pulse Amplitude** indicator displays low level modulation

2. Press the SRC-MAX **Pulse Rate** select button.

The SRC-MAX **Pulse Rate 60** LED lights.

The monitor pulse rate decreases to 60 and stabilize at 60 bpm. The test pass criteria is 57 to 63 bpm inclusive.

The monitor:

- displays 75 %SpO2
- displays 60 bpm (test pass criteria is 57 to 63 bpm inclusive)
- alarms
- **Pulse Amplitude** indicator displays low level modulation

Test 2: SpO2

To perform Test 2: SpO2:

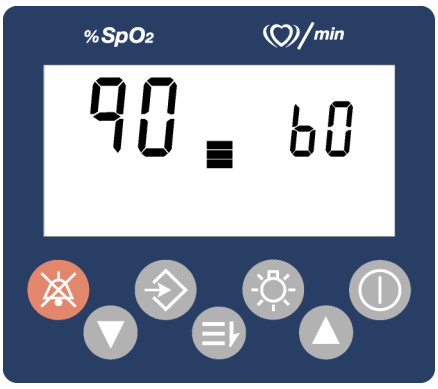
1. Press the SRC-MAX **%SpO2** select button.

The SRC-MAX **%SpO2 90** LED lights.

The monitor displays three dashes until the SRC-MAX stabilizes at 90 %SpO2. The test pass criteria is 88 to 92 %SpO2 inclusive.

The monitor:

- displays 90 %SpO2 (pass criteria is 88 to 92 %SpO2 inclusive)
- displays 60 bpm
- no alarms
- **Pulse Amplitude** indicator displays low level modulation



2. Press the SRC-MAX **%SpO2** select button.

The SRC-MAX **%SpO2 75** LED lights.

The monitor displays two dashes until the SRC-MAX stabilizes at 75 %SpO2. The test pass criteria is 73 to 77 %SpO2 inclusive.

The monitor:

- displays 75 %SpO2 (pass criteria is 73 to 77 %SpO2 inclusive)
- displays 60 bpm
- alarms
- **Pulse Amplitude** indicator displays low level modulation

Test 3: Modulation Level

To perform Test 3: Modulation Level:

1. Press the SRC-MAX % **Modulation** selection button.

The SRC-MAX % **Modulation** ▲ LED lights.

The monitor pulse blip bar initially increases in amplitude and then stabilizes at the higher level.

The monitor:

- displays 75 %SpO2 (test pass criteria is 73 to 77 %SpO2 inclusive)
- displays 60 bpm (test pass criteria is 57 to 63 bpm inclusive)
- alarms
- **Pulse Amplitude** indicator displays high level modulation

2. Perform *Test 1: BPM* on page 32.

   The **Pulse Amplitude** indicator should indicate high level modulation.

3. Perform *Test 2: SpO2* on page 33.

   The **Pulse Amplitude** indicator should indicate high level modulation.

4. Press the SRC-MAX % **Modulation** selection button.

   The SRC-MAX % **Modulation** ▼ LED lights.

   The monitor pulse blip bar decreases in amplitude.

   The monitor:

   - displays 75 %SpO2
   - displays 60 bpm
   - alarms
   - **Pulse Amplitude** indicator displays low level modulation

5. Perform *Test 1: BPM* on page 32.

   The pulse amplitude indicator should indicate low level modulation.

6. Perform *Test 2: SpO2* on page 33.

   The pulse amplitude indicator should indicate low level modulation.

Test 4: Light Level

To perform Test 4: Light Level:

1. Press the SRC-MAX **Light Level** selection button.

   The SRC-MAX **Light Level** ▲ LED lights.

   The monitor pulse blip bar initially increases in amplitude and then reduces and stabilizes at 3-5 bars.

   The monitor:

   - displays 75 %SpO2 (test pass criteria is 73 to 77 %SpO2 inclusive)
   - displays 60 bpm (test pass criteria is 57 to 63 bpm inclusive)
   - alarms
   - pulse amplitude indicator displays low level modulation

2. Perform *Test 1: BPM* on page 32.

   The pulse amplitude should indicate low level modulation.

3. Perform *Test 2: SpO2* on page 33.

   The pulse amplitude should indicate low level modulation.

4. Press the SRC-MAX **Light Level** selection button.

   The SRC-MAX **Light Level** ▼ LED lights.

   The monitor pulse blip bar initially increases in amplitude and then reduces and stabilizes at 3-5 bars.

   The monitor:

   - displays 75 %SpO2
   - displays 60 bpm
   - alarms
   - pulse amplitude indicator displays low level modulation

5. Perform *Test 1: BPM* on page 32.

   The pulse amplitude indicator should indicate low level modulation.

6. Perform *Test 2: SpO2* on page 33.

   The pulse amplitude indicator should indicate low level modulation.

7. Disconnect all equipment and turn off the monitor.

Safety Tests

The monitor safety tests meet the standards of, and are performed in accordance with, EN 60601-1: 1990 (A1 and A2), IEC 60601-1, UL 60601-1, and CAN/CSA C22.2 No. 601.1. This product is categorized as internally powered type BF equipment.

Blank Page

Troubleshooting

Introduction

This section explains how to troubleshoot the *OxiMax* N-65. Tables list possible monitor difficulties, along with probable causes, and recommended actions to correct the difficulty.

How To Use This Section

Use this section in conjunction with *Performance Verification* on page 17, and *Spare Parts* on page 61. To remove and replace a part suspected of being defective, follow the instructions in *Disassembly Guide* on page 47. The circuit analysis section in the *Technical Discussion* on page 81, offers information on how the monitor functions.

Who Should Perform Repairs

Only qualified service personnel should open the monitor housing, remove and replace components, or make adjustments. If your medical facility does not have qualified service personnel, contact Nellcor's Technical Services or your local Nellcor representative.

Troubleshooting Guide

Note: Follow the recommended actions discussed in this section to correct the majority of problems you may encounter. However, problems not covered here can be resolved by calling Nellcor's Technical Services or your local Nellcor representative.

If you encounter a problem that cannot be resolved through a visual inspection, refer to Table 4: *Troubleshooting Guide*, on page 40. In the table, find the condition that describes the problem and follow the corrective actions in the order presented. For a symptom that is not listed in Table 4, contact the Nellcor Technical Services Department at 1.800.635.5267 or your local Nellcor representative.

If an error code is shown on the monitor front panel display, see Figure 3. Turn the monitor off, wait ten seconds, then turn it back on. This clears recoverable errors encountered by the monitor. If the error code persists, refer to Table 5: *Error Codes*, on page 43 for an explanation of the error code. Apply the action specified.

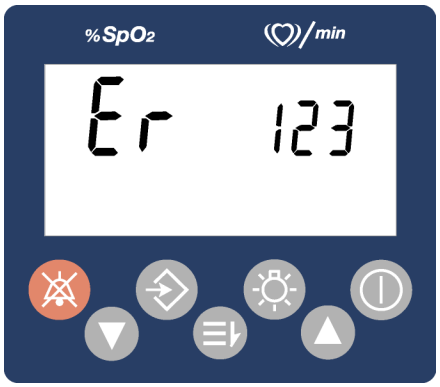


Figure 3: Typical Error Code Display

Once you have performed the recommended action, reassemble the monitor, refer to *Performance Verification* on page 17, and conduct a performance verification before returning the monitor to service. If the symptom persists continue troubleshooting.

Table 4: Troubleshooting Guide

Condition	Recommended Action
The monitor does not turn on when you press the Power button.	
• The **Power** button was not fully depressed.	Fully press the **Power** button.
• The batteries are missing.	Open the battery compartment. If the batteries are missing, install new batteries. Refer to the *OxiMax* N-65 Operator's Manual.
• The batteries are installed incorrectly.	Open the battery compartment. If the batteries are not installed correctly, remove and reinstall them. Make sure the batteries are not installed backwards. Refer to the *OxiMax* N-65 Operator's Manual.
• The batteries are at, or near, a voltage too low for the monitor to operate.	Install new batteries. Refer to the *OxiMax* N-65 Operator's Manual.
• The flex circuit between the front panel and the SpO2 PCB is damaged, or not making a good connection.	**Caution: Unlock J4 before attempting to remove and reinsert the flex cable.** Inspect the flex cable for damage. Inspect the connection to J4. If there is damage to the flex cable, replace the front case. Otherwise, remove the cable from J4 and reconnect it. Reassemble the monitor and retest. Refer to *Separating the Front and Back Cases* on page 48 and *Front Case Assembly Replacement* on page 54.
• The front panel keypad is defective.	**Caution: Unlock J4 before attempting to remove the flex circuit cable.** Replace the Front Case. Refer to *Front Case Assembly Replacement* on page 54.

Table 4: Troubleshooting Guide (Continued)

Condition	Recommended Action
• Replacing the front case does not fix the problem.	Replace the SpO2 PCB. See *SpO2 PCB or User Interface PCB Replacement* on page 50.
• Replacing the SpO2 PCB does not fix the problem.	Replace the User Interface PCB. See *SpO2 PCB or User Interface PCB Replacement* on page 50. If this does not fix the problem, return the monitor to Nellcor.
One or more keys on the front panel keypad does not work.	
• The flex circuit between the front panel and the SpO2 PCB is damaged, or not making a good connection.	**Caution: Unlock J4 before attempting to remove and reinsert the flex cable.** Inspect the flex cable for damage. Inspect the connection to J4. If there is damage to the flex cable, replace the front case. Otherwise, remove the cable from J4 and reconnect it. Reassemble the monitor and retest. Refer to *Separating the Front and Back Cases* on page 48 and *Front Case Assembly Replacement* on page 54.
• The front panel keypad is defective.	**Caution: Unlock J4 before attempting to remove the flex circuit cable.** Replace the front case. Refer to *Front Case Assembly Replacement* on page 54.
• Replacing the front case does not fix the problem.	Replace the SpO2 PCB. *SpO2 PCB or User Interface PCB Replacement* on page 50.
• Replacing the SpO2 PCB does not fix the problem.	Replace the User Interface PCB. See *SpO2 PCB or User Interface PCB Replacement* on page 50. If this does not fix the problem, return the monitor to Nellcor.
One or more display segments does not work.	
• A User Interface PCB component has failed.	Inspect the User Interface PCB for cracking, burning, or damage. If damage is found, replace the User Interface PCB. See *SpO2 PCB or User Interface PCB Replacement* on page 50.
• The User Interface PCB is defective.	If damage is found, replace the User Interface PCB. See *SpO2 PCB or User Interface PCB Replacement* on page 50.
Pulse rate and %SpO2 value does not display when the monitor is turned on.	
• The SpO2 sensor is not connected properly.	Reconnect the SpO2 sensor to the monitor. Connect the SpO2 sensor to the patient. See the sensor Directions for Use.
• The SpO2 sensor has failed.	Replace the SpO2 sensor.
• The User Interface PCB is defective.	Replace the User Interface PCB. See *SpO2 PCB or User Interface PCB Replacement* on page 50.
• The SpO2 PCB is defective.	Replace the SpO2 PCB. See *SpO2 PCB or User Interface PCB Replacement* on page 50.
The display backlight does not come on when you press the Backlight button.	
• The flex circuit between the front panel and the SpO2 PCB is damaged, or not making a good connection.	**Caution: Unlock J4 before attempting to remove and reinsert the flex cable.** Inspect the flex cable for damage. Inspect the connection to J4. If there is damage to the flex cable, replace the front case. Otherwise, remove the cable from J4 and reconnect it. Reassemble the monitor and retest. See *Separating the Front and Back Cases* on page 48 and *Front Case Assembly Replacement* on page 54.

Table 4: Troubleshooting Guide (Continued)

Condition	Recommended Action
• The **Backlight** button on the front panel keypad is defective.	**Caution: Unlock J4 before attempting to remove the flex circuit cable.** Replace the front case. See *Front Case Assembly Replacement* on page 54.
• Replacing the SpO2 PCB does not fix the problem.	Replace the SpO2 PCB. See *SpO2 PCB or User Interface PCB Replacement* on page 50.
• Replacing the SpO2 PCB does not fix the problem.	Replace the User Interface PCB. See *SpO2 PCB or User Interface PCB Replacement* on page 50. If this does not fix the problem, return the monitor to Nellcor.
• The **Backlight LED**s on the User Interface PCB have failed.	Replace the User Interface PCB. See *SpO2 PCB or User Interface PCB Replacement* on page 50.
The monitor shuts off when you press the Backlight button.	
• The batteries are, at or near, a voltage too low for the monitor to operate.	Install new batteries. See the *OxiMax* N-65 Operator's Manual.
The printer does not print.	
• The IrDA between the printer and the monitor is not properly aligned.	Align the printer and the monitor. See the *OxiMax* N-65 Operator's Manual for instructions.
• The printer is turned off.	Turn the printer on. See the printer documentation.
• The printer batteries are at, or near, a voltage too low to operate.	Install new batteries in the printer. See the printer documentation.
• The **Data** button on the front panel keypad is defective.	**Caution: Unlock J4 before attempting to remove the flex circuit cable.** Replace the Front Case. See *Front Case Assembly Replacement* on page 54.
• Replacing the Front Case does not fix the problem.	Replace the User Interface PCB. See *SpO2 PCB or User Interface PCB Replacement* on page 50. If this does not fix the problem, return the monitor to Nellcor.
• The printer is defective.	See the printer documentation, or replace the printer.

Error Codes

An error code displays when the monitor detects a non-correctable failure. Table 5 provides a list of error codes for the monitor. However, you can turn the **Power** off and on once (called "cycling" the power) to try removing the error code if one of the following occurs:

- monitor sounds a low priority alarm
- measurements stop
- "Er" is shown in the %SpO2 numeric display area
- Error code is shown in the right numeric display

If the error code remains, see *Error Codes* on page 43.

Table 5 provides a list of error codes for the monitor.

Table 5: Error Codes

Error Code	Scope of Action			Action	Explanation
	Clinician	Repair	Return		
1		X		Replace SpO2 board.	SpO2 front end RAM error.
2		X		Replace SpO2 board.	SpO2 front end ROM/code integrity error.
3		X		Replace SpO2 board.	SpO2 front end reported a bad CRC.
4		X		Replace SpO2 board.	SpO2 front end reported FSP message not allowed.
5		X		Replace SpO2 board.	SpO2 front end reported illegal value sent in FSP message.
6		X		Replace SpO2 board.	SpO2 front end reports calibration (offset) failure.
9		X		Replace SpO2 board.	SpO2 front end reported syntax error in FSP message.
10	1	2		1 — Check/replace sensor/ extension cable. 2 — Replace SpO2 board.	SpO2 front end reports over current failure.
11	1	2		1 — Replace batteries. 2 — Replace SpO2 board.	SpO2 front end reports incorrect system voltage.
12		X		Replace SpO2 board.	SpO2 front end reports other hardware problem.
14		X		Replace SpO2 board.	SpO2 front end reports communication channel overflow.
16		X		Replace SpO2 board.	SpO2 front end reports watchdog time out.
17	X			Check/replace sensor/ extension cable.	SpO2 front end reports that sensor appears defective.
18		X		Replace SpO2 board.	SpO2 front end reports internal register appears modified from expected value.
19	X			Check/replace sensor/ extension cable.	SpO2 front end reports signal out-of-range.
48		X		Replace SpO2 board.	SpO2 front end reports spurious interrupt.
49		X		Replace SpO2 board.	SpO2 front end reports internal buffer overflow.
50		X		Replace SpO2 board.	SpO2 front end reports intermittent error.
51		X		Replace SpO2 board.	SpO2 front end reports digital communication error.
53		X		Replace SpO2 board.	SpO2 front end data not received.
256		X		Replace SpO2 board.	SpO2 back end reports beginning of packet missing.

Table 5: Error Codes (Continued)

Error Code	Scope of Action			Action	Explanation
	Clinician	Repair	Return		
257		X		Replace SpO2 board.	SpO2 back end reports packet start ID (SID) missing.
258		X		Replace SpO2 board.	SpO2 back end reports packet length error.
259		X		Replace SpO2 board.	SpO2 back end reports message length error.
260		X		Replace SpO2 board.	SpO2 back end reports packet contains unsupported key.
261		X		Replace SpO2 board.	SpO2 back end reports packet CRC error.
262		X		Replace SpO2 board.	SpO2 back end reports end of packet missing.
263		X		Replace SpO2 board.	SpO2 back end reports packet contains unidentified key.
264		X		Replace SpO2 board.	SpO2 back end reports corrupted variable.
265		X		Replace SpO2 board.	SpO2 back end reports memory overflow.
266		X		Replace SpO2 board.	SpO2 back end reports bad pointer.
267		X		Replace SpO2 board.	SpO2 back end reports parameter value out-of-range.
268		X		Replace SpO2 board.	SpO2 back end reports reset detected.
269		X		Replace SpO2 board.	SpO2 back end reports unexpected value.
270		X		Replace SpO2 board.	SpO2 back end reports time-out.
271		X		Replace SpO2 board.	SpO2 back end reports not ready/not initialized.
272		X		Replace SpO2 board.	SpO2 back end reports double fault.
273	1, 2	3		1 — Restart the monitor. 2 — Set the time and date. 3 — Replace UI board.	SpO2 back end reports date out-of-range error.
274			X	Return monitor for reprogramming.	SpO2 back end reports incompatible software version.
275	X			Check/replace sensor/ extension cable.	SpO2 back end reports incorrect registration number.
276	X			Replace with OXIMAX sensor/ extension cable.	SpO2 back end reports sensor read failure.
277	X			Check/replace sensor/ extension cable.	SpO2 back end reports sensor signature verification fails.
280	X			Check/replace sensor/ extension cable.	SpO2 back end reports does not support feature required by sensor.
281	X			Check/replace sensor/ extension cable.	SpO2 back end reports overflow/ underflow.
282	X			Check/replace sensor/ extension cable.	SpO2 back end reports sensor activation failure.

Table 5: Error Codes (Continued)

Error Code	Scope of Action			Action	Explanation
	Clinician	Repair	Return		
512		X		Replace UI board.	Communication failure with real time clock.
513		X		Replace UI board.	Real time clock oscillator control problem.
514		X		Replace UI board.	Real time clock failed timing test.
515		X		Replace UI board.	LCD failed feedback test.
516		X		Replace UI board.	LCD failed feedback test.
518			X	Return monitor for repair.	Various system faults.
519			X	Return monitor for repair.	Unrecoverable software error.
520		X		Replace UI board.	Unrecoverable error verify real time clock.
521	X			Replace batteries.	Battery power is critically low.
522	X			Replace batteries.	System power levels unacceptable for continued operation.
523	1, 2	3		1 — Restart the monitor. 2 — Set the time and date. 3 — Replace UI board.	NVRAM failed consistency check.
524		X		Replace UI board.	NVRAM failed read-after-write verification.
525	X	X		Restart, replace UI board.	Time base discrepancy writing error entry.
526		1, 2		1 — Replace SpO2 board. 2 — Replace UI board.	Fatal error for SpO2 communication.
527		1, 2		1 — Replace SpO2 board. 2 — Replace UI board.	Communication failure with SpO2 board.
528		1	2	1 — Replace UI board 2 — Return monitor for repair.	Fatal error creating parser.
529		1	2	1 — Replace UI board 2 — Return monitor for repair.	Fatal error creating parser.
530		1, 2		1 — Replace SpO2 board. 2 — Replace UI board.	Unrecoverable error with SpO2 communication.
531		1, 2		1 — Replace SpO2 board. 2 — Replace UI board.	Unrecoverable error with SpO2 communication.
532		1, 2		1 — Replace SpO2 board. 2 — Replace UI board.	Unrecoverable error with SpO2 communication.
533		1, 2		1 — Replace SpO2 board. 2 — Replace UI board.	Unrecoverable error with SpO2 communication.
534		1, 2		1 — Replace SpO2 board. 2 — Replace UI board.	Unrecoverable error with SpO2 communication.
535		1, 2		1 — Replace SpO2 board. 2 — Replace UI board.	Unrecoverable error with SpO2 communication.
536		X		Replace UI board.	Flash memory failed CRC check.
537		X		Replace UI board.	Fatal system error.
538	X			Set the monitor time and date.	Real time clock value bad.

Table 5: Error Codes (Continued)

Error Code	Scope of Action			Action	Explanation
	Clinician	Repair	Return		
539	1	2		1 — Restart the monitor. 2 — Replace membrane switch pad.	Erroneous key press detected at start.
540		X		Replace UI board.	Fatal system error reading memory.
541			X	Return monitor for repair.	Fatal software error.
542		1	2	1 — Replace UI board. 2 — Return monitor for repair.	RAM corruption detected during background check.
543	X			Set time and date.	Invalid time. Cannot snapshot.
544		X		Replace UI board.	Invalid register value.
545		X		Replace SpO_2 board.	SpO_2 board in unexpected state.
546		X		Replace UI board.	IrDA failure.
997		X		Replace UI board.	RAM error.
998		X		Replace UI board.	Spurious Interrupt.
999		X		Replace UI board.	Watchdog protection activated.

Disassembly Guide

Introduction

The *OxiMax* N-65 can be disassembled into all major component parts, including:

- Front case with front panel keypad
- Rear bottom
- User Interface PCB
- SpO_2 PCB
- Battery compartment door

Note: Some spare parts have a business reply card attached. Please fill out and return the business reply card.

Caution: Observe ESD (electrostatic discharge) precautions when disassembling and reassembling the monitor and when handling any components of it.

Tools Required

The tools required to disassemble and reassemble the monitor are:

- Number one (medium) Phillips screwdriver
- Torque driver, four inch/pounds (10 cm/kg)

Replacement Level Supported

The replacement level supported for the monitor is at the printed circuit board (PCB) and major subassembly level. When a PCB problem is identified, follow the procedures in *Disassembly Guide* on page 47 to replace the PCB. Check to ensure the symptom disappears and that the monitor passes all performance tests. If the symptom persists, swap the replacement PCB with the malfunctioning PCB (the original PCB that was installed when you started troubleshooting) and continue troubleshooting.

Prior to Disassembly

The monitor batteries must be removed prior to disassembly.

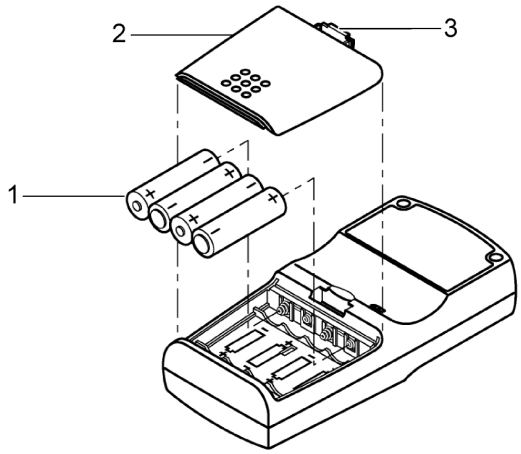
To remove the batteries:

1. Press the **Power** button to turn the monitor off.

2. Remove the battery cover.

3. Pull the battery cover latch downward toward the bottom of the monitor case and lift the battery cover. See Figure 4, item 1.

4. Remove the batteries.



1 — Batteries
2 — Battery cover
3 — Battery cover latch

Figure 4: Removing Batteries

Separating the Front and Back Cases

To separate the monitor front and back cases:

1. Do the procedure in paragraph *Prior to Disassembly* on page 48.

2. Remove the four screws holding the monitor front and rear cases together. See Figure 5, items 1 through 4.

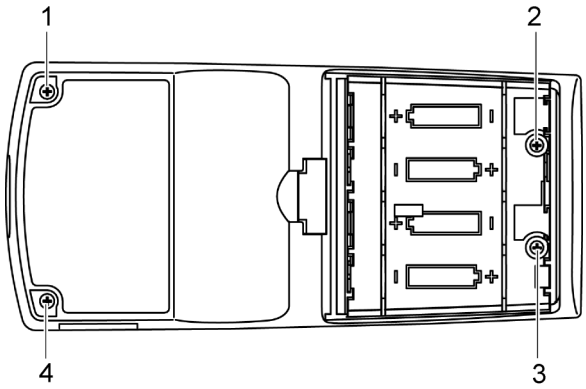
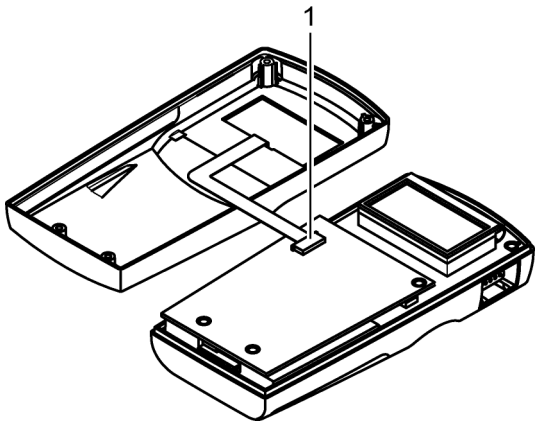


Figure 5: Monitor Case Screws

Caution: A flex cable runs between the monitor front and rear case assemblies. Use care when separating the cases. Do not apply stress to the flex cable.

3. Separate the monitor front and rear case assemblies. See Figure 6.

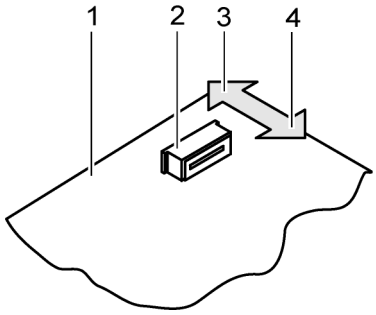


1 — Connector J4

Figure 6: Cases Separated

Caution: Failure to unlock connector J4 on the SpO_2 PCB before removing the front case flex circuit could damage the flex circuit.

4. Unlock connector J4 on the SpO2 PCB. See Figure 6 and Figure 7.



1 — SpO2 PCB .
2 — J4 lock
3 — Lock direction
4 — Unlock direction

Figure 7: SpO2 PCB Connector J4 Lock

5. Disconnect the ribbon cable from SpO2 PCB connector J4.

SpO2 PCB or User Interface PCB Replacement

To replace the SpO2 PCB or the User Interface PCB:

1. Complete the procedure in *Prior to Disassembly* on page 48.

2. Complete the procedure in *Separating the Front and Back Cases* on page 48.

Caution: The battery connectors (spring assemblies) at the bottom of the SpO2 PCB are held in slots in the battery compartment. Observe how the connectors are engaged in the slots when you remove the SpO2 PCB and User Interface PCB. Ensure that the battery connectors are inserted back into these slots when you reassemble the monitor.

3. Pull the SpO2 PCB and User Interface PCB to the left to free the case from the DB-9 connector. Lift the combined SpO2 and User Interface PCBs from the case. See 8.

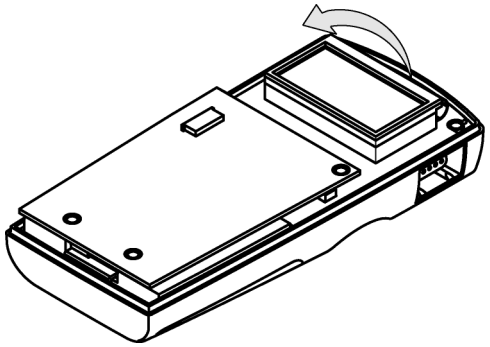
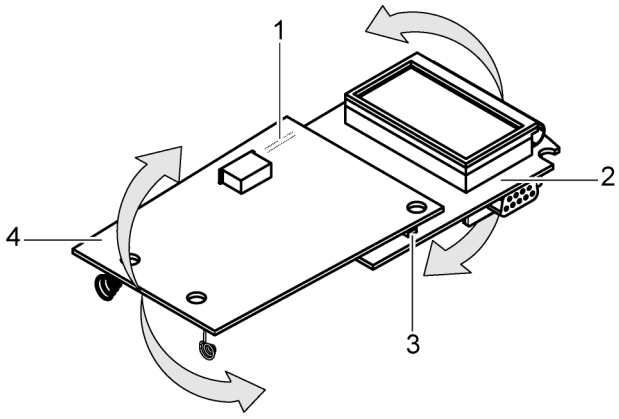


Figure 8: User Interface PCB and SpO2 PCB Removal

Caution: Do not force the User Interface PCB and SpO2 PCB apart. This may damage the boards. To separate the User Interface PCB from the SpO2 PCB, grasp the User Interface PCB in one hand and the SpO2 PCB in the other. Rotate the ends of the two PCBs as shown in Figure 9 until the two PCBs separate at the connection points. Gently work the boards apart.

4. Separate the User Interface PCB from the SpO2 PCB. See the Caution above and Figure 9 as follows.

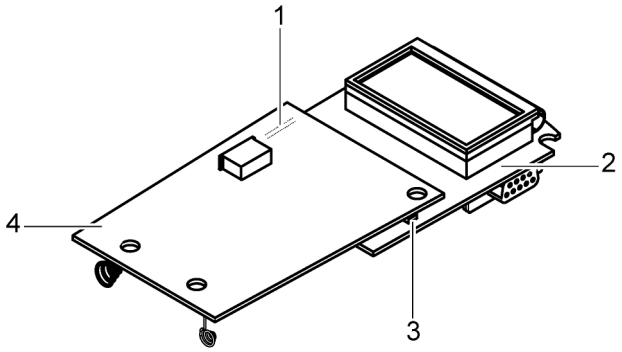


1 — Left Connection (J8 on SpO2, J4 on User Interface)
2 — User Interface PCB
3 — Right Connection (J1 on SpO2, J5 on User Interface)
4 — SpO2 PCB

Figure 9: Separating the User Interface PCB and SpO2 PCB

5. Place the defective PCB to the side.

6. Align the replacement PCB with the other PCB at the connectors. When both rows of the connectors are aligned, gently press the PCBs together. See Figure 10.



1 — Left Connection (J8 on SpO2, J4 on User Interface)
2 — User Interface PCB
3 — Right Connection (J1 on SpO2, J5 on User Interface)
4 — SpO2 PCB

Figure 10: Connecting PCBs

7. Install the User Interface PCB and SpO2 PCB into the monitor case. Ensure that the battery springs are aligned properly in their slots. See Figure 11.

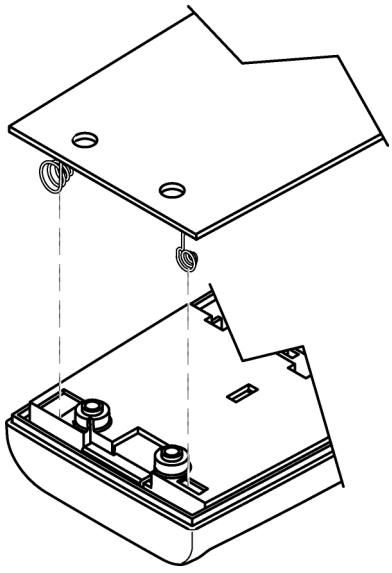


Figure 11: Battery Spring Alignment

Note: The longer screws install at the top of the case. See Figure 12, items 1 and 4.

8. Align the front and rear cases. See Figure 12.

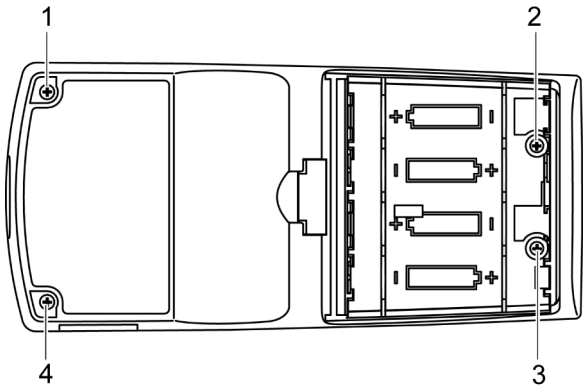
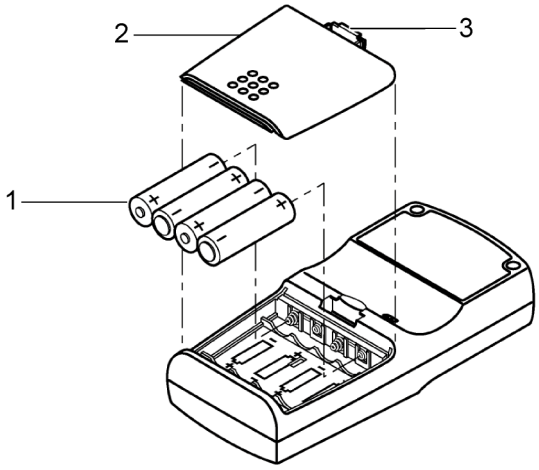


Figure 12: Installing The Case Screws

9. Install the four screws (Figure 12, items 1 through 4).

10. Install the batteries and battery cover. See Figure 13.



1 — Batteries
2 — Battery cover
3 — Battery cover latch

Figure 13: Battery Installation

11. Perform the performance verification tests before placing the monitor into service. See *Pulse Oximetry Functional Tests* on page 28.

Front Case Assembly Replacement

The front case assembly contains the keypad.

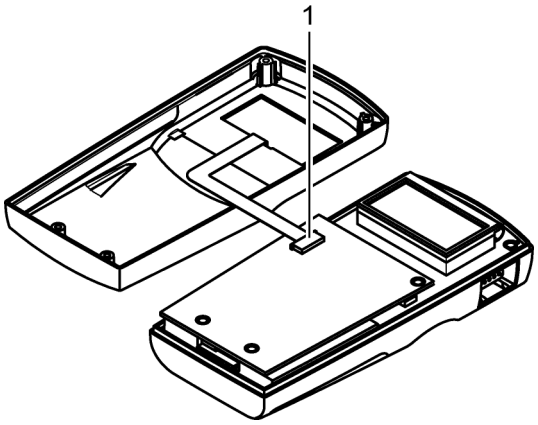
To replace the front case assembly:

1. Remove the batteries from the monitor. See *Prior to Disassembly* on page 48.

2. Separate the front and rear case assemblies. See *Separating the Front and Back Cases* on page 48.

3. Dispose of the front case assembly in accordance with local regulations.

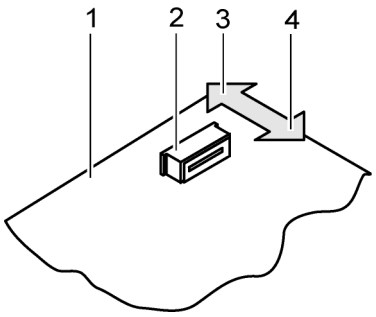
4. Connect the new front case assembly ribbon cable to the SpO2 PCB connector J4. See Figure 14.



1 — J4

Figure 14: Front Case Ribbon Cable Connection

5. Lock the ribbon cable connector. See Figure 15.



1 — SpO2 PCB
2 — J4 lock
3 — Lock direction
4 — Unlock direction

Figure 15: Locking SpO2 PCB Connection to J4

6. Place the front and rear cases together and install the four screws. See Figure 16, items 1 through 4.

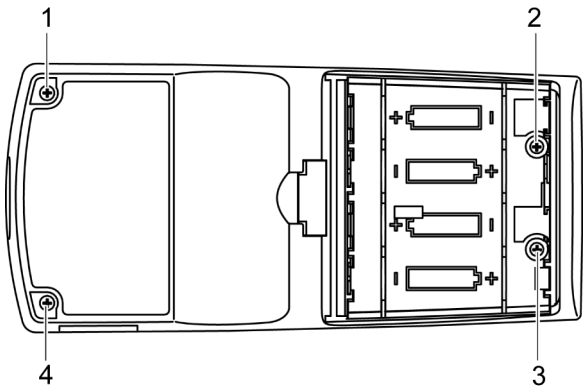
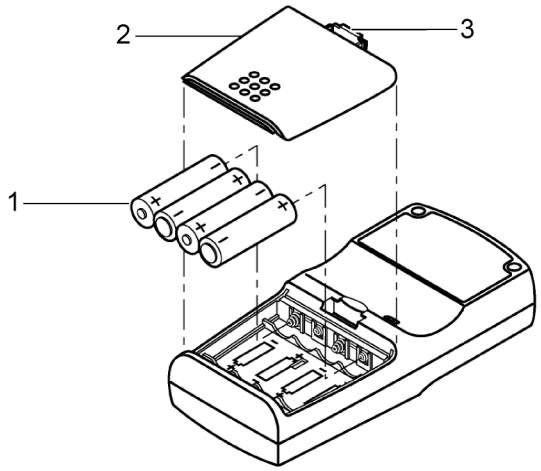


Figure 16: Installing The Case Screws

7. Install the batteries and battery cover as shown in Figure 17.



1 — Batteries
2 — Battery cover
3 — Battery cover latch

Figure 17: Battery Installation

8. Perform the performance verification tests before placing the monitor into service. See *Pulse Oximetry Functional Tests* on page 28.

Rear Case Assembly Replacement

To replace the rear case assembly:

1. Remove the batteries from the monitor. See *Prior to Disassembly* on page 48.

2. Separate the front and rear case assemblies. See *Separating the Front and Back Cases* on page 48.

Caution: The battery connectors (spring assemblies) at the bottom of the SpO2 PCB are held in slots in the battery compartment. Observe how these connectors are engaged in these slots when you remove the SpO2 PCB and User Interface PCB and ensure that the battery connectors are inserted back in these slots when you reassemble the monitor.

3. Lift the SpO2 PCB and User Interface from the case. See 18.

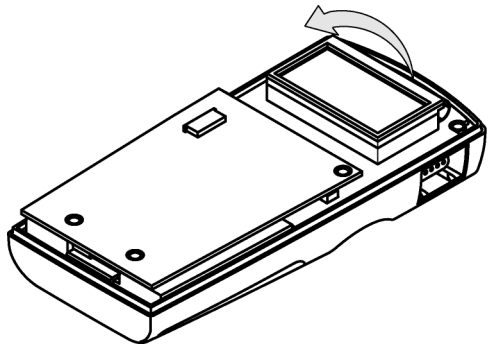


Figure 18: User Interface PCB and SpO2 PCB Removal

4. Discard the rear case assembly in accordance with local regulations.

5. Install the User Interface PCB and SpO2 PCB into the monitor case. Ensure that the battery springs slip into place. See Figure 19.

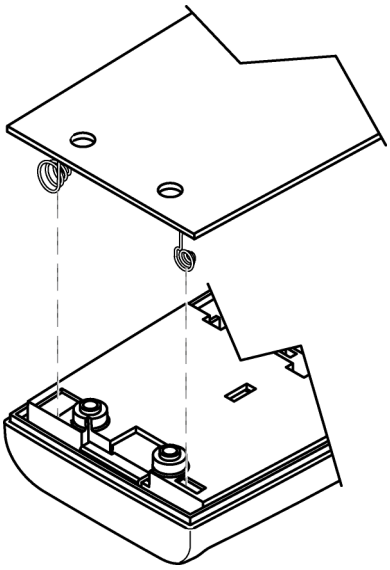


Figure 19: Battery Spring Alignment

Note: The longer screws install at the top of the case. See Figure 20, items 1 and 4.

6. Place the front and rear cases together and install the four screws. See Figure 20.

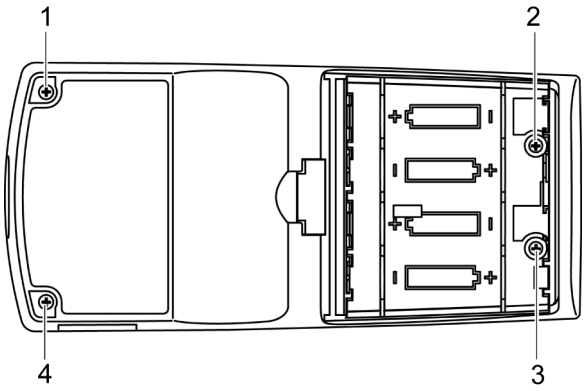


Figure 20: Installing The Case Screws

7. Install the batteries and battery cover. See Figure 21.

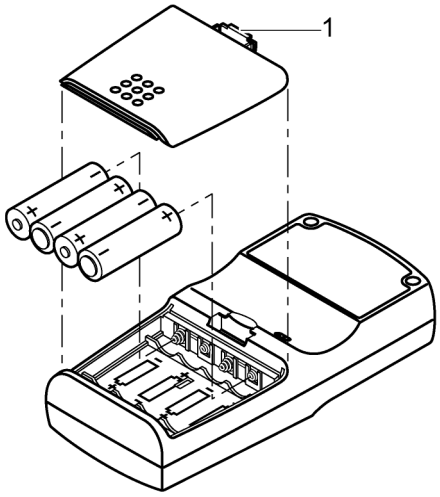


Figure 21: Battery Installation

8. Perform the performance verification tests before placing the monitor into service. See *Pulse Oximetry Functional Tests* on page 28.

Battery Compartment Door Replacement

To replace the battery compartment door:

1. Press the battery door latch (Figure 22, item 1) and lift the batter door from the monitor rear case.

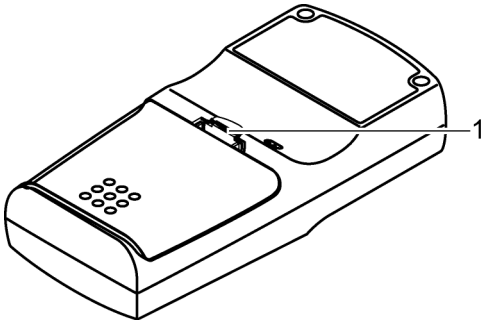


Figure 22: Battery Compartment Door Latch

2. Insert the new battery compartment door in the case and close until the battery door latch snaps in place.

Blank Page

Spare Parts

Introduction

The latest version of this manual is available on the Internet at:

http://www.mallinckrodt.com/respiratory/resp/Serv_Supp/ProductManuals.html

Spare parts are shown in Table 6. Item numbers correspond to the callout numbers in Figure 23.

Obtaining Replacement Parts

Nellcor's Technical Services provides technical assistance information and replacement parts. To obtain replacement parts, contact Nellcor's Technical Services or your local Nellcor representative. Refer to parts by the part names and part numbers.

Spare parts and accessories for the *OxiMax* N-65 are listed on the Internet at:

http://mallinckrodt.com/respiratory/resp/Serv_Supp/Apartweb/main/PartAcceMenu.html

Parts List and Accessories

Table 6: Parts and Accessories List

Figure 23 Reference	Description
Spare Parts	
1	Top enclosure with membrane panel
2	SpO2 PCB
3	User interface (UI)
4	Bottom enclosure
5	Battery cover
--	Membrane switch panel
--	LCD assembly
--	Battery, alkaline, 1.5V, type AA
--	Screw, PH, 4 X /16 inch
--	Screw, PH, 4 X 3/16 inch

Table 6: Parts and Accessories List

Figure 23 Reference	Description
--	Product data label
--	Quick guide label
Accessories	
--	Boot, protective, silicone, yellow
--	Case, carry, fabric, black with shoulder strap
--	DEC-4 sensor extension cable
--	Jacket, water resistant, clear, plastic
--	Transport Boot
--	CD, operator and service manuals
--	Home Use Guide, English
--	Operator’s manual, Arabic
--	Operator’s manual, Chinese
--	Operator’s manual, Czechoslovakian
--	Operator’s manual, Danish
--	Operator’s manual, Dutch
--	Operator’s manual, English
--	Operator’s manual, Finnish
--	Operator’s manual, French
--	Operator’s manual, German
--	Operator’s manual, Greek
--	Operator’s manual, Hungarian
--	Operator’s manual, Italian
--	Operator’s manual, Japanese
--	Operator’s manual, Norwegian
--	Operator’s manual, Polish
--	Operator’s manual, Portuguese (Brazilian)
--	Operator’s manual, Russian
--	Operator’s manual, Spanish (Latin American)
--	Operator’s manual, Swedish
--	Operator’s manual, Turkish

Figure 23 shows the monitor exploded view with numbers relating to the spare parts list.

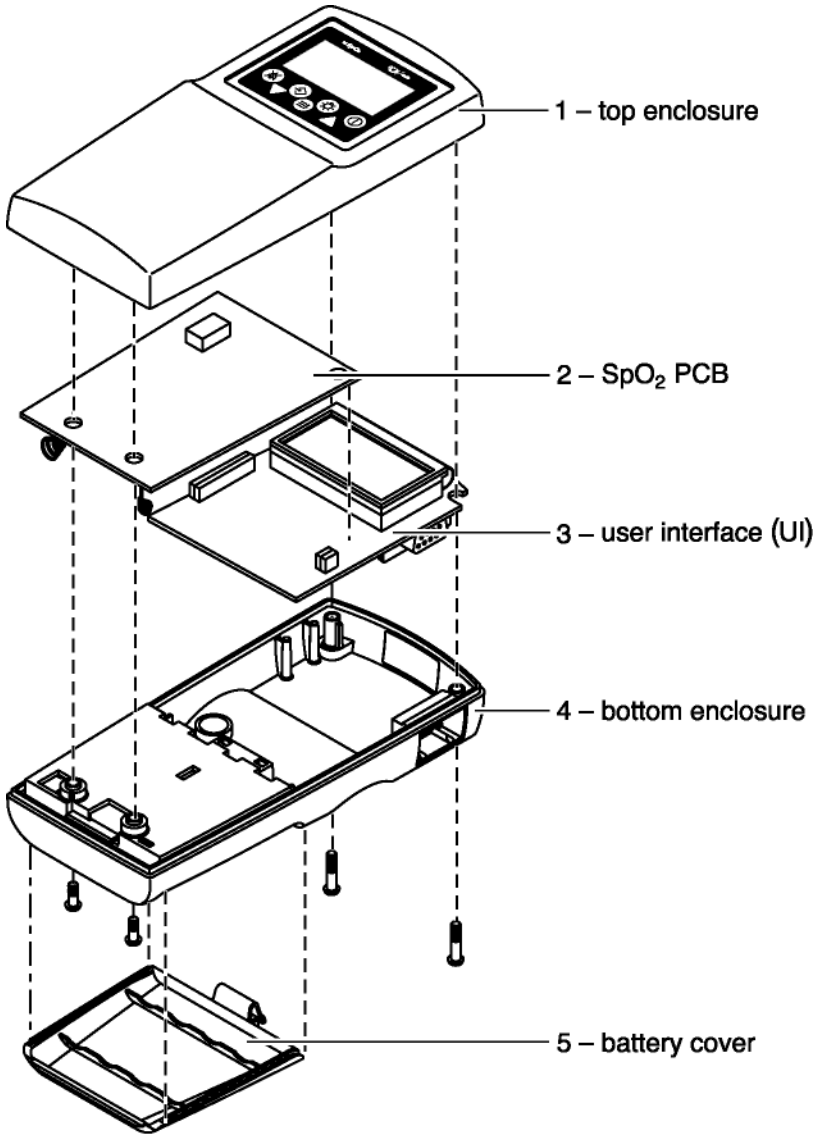


Figure 23: Exploded View

Blank Page

Packing for Shipment

Introduction

To ship the *OXIMAX* N-65, follow the instructions in this section.

Returning the Monitor

Contact Nellcor's Technical Services Department for shipping instructions, including a Returned Goods Authorization (RGA) number. Unless otherwise instructed by Nellcor's Technical Services Department, it is not necessary to return the *OXIMAX* sensor or other accessory items with the monitor. Pack the monitor in its original shipping carton. If the original carton is not available, use a suitable carton with appropriate packing material to protect it during shipping.

Return the monitor by any shipping method that provides proof of delivery.

Repacking in Original Carton

If available, use the original carton and packing materials. See Figure 24. Pack the monitor as follows:

To repackage the monitor in the original carton:

1. Place the monitor in original packaging.

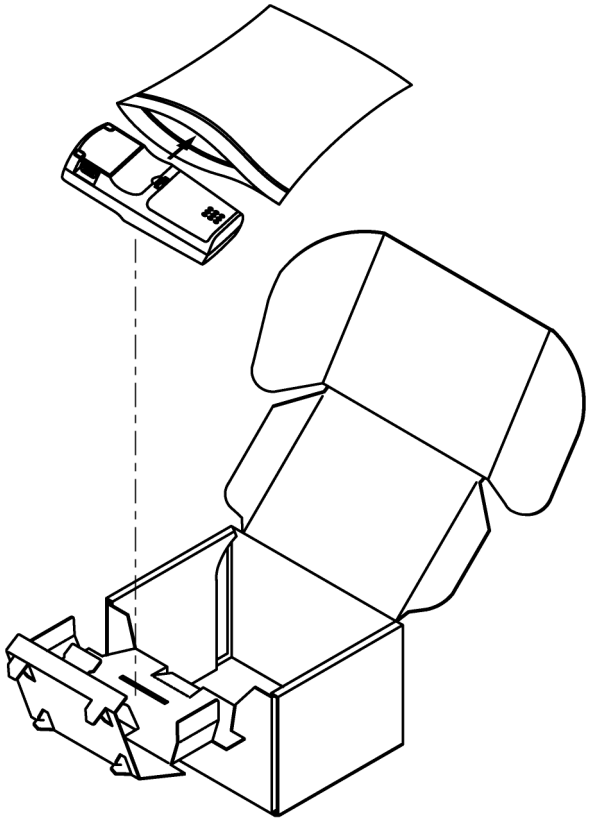


Figure 24: Packing

2. Place in shipping carton and seal carton with packing tape.

3. Label carton with shipping address, return address, and RGA number.

Packing in a Different Carton

If the original carton is not available, repackage the monitor in a different carton.

To repackage the monitor in a different carton:

1. Place the monitor in a plastic bag.

2. Locate a corrugated cardboard shipping carton with a bursting strength of at least 200 pounds per square inch (psi).

3. Fill the bottom of the carton with at least two inches of packing material.

4. Place the bagged unit on the layer of packing material and fill the box completely with packing material.

5. Seal the carton with packing tape.

6. Label the carton with the shipping address, return address, and RGA number.

Blank Page

Specifications

Performance

Measurement Range

SpO_2	1% to 100%
Pulse Rate	20 beats per minute (bpm) to 250 bpm
Perfusion Range	0.03% to 20%

Accuracy Tolerance

Saturation	
Adult[1]	70 to 100% ±2 digits
Neonate	70 to 100% ±3 digits
Low Perfusion[2]	70 to 100% ±2 digits
Pulse Rate	
Adult and Neonate[1]	20 to 250 bpm ±3 digits
Low Perfusion [2]	20 to 250 bpm ±3 digits

[1] Adult specifications are shown for *OxiMax* MAX-A and MAX-N sensors with the N-65. Neonate specifications are shown for *OxiMax* MAX-N sensors with the N-65. Saturation accuracy will vary by sensor type. Refer to the Sensor Accuracy Grid. The Sensor Accuracy Grid is shipped with the N-65. The latest version of the Sensor Accuracy Grid is available on the Internet at:

http://www.mallinckrodt.com/respiratory/resp/Serv_Supp/ProductManuals.html

[2] Reading accuracy in the presence of low perfusion (detected IR pulse modulation amplitude <1.5%) was validated using signals supplied by a patient simulator. SpO2 and pulse rate values were varied across the monitoring range over a range of weak signal conditions and compared to the known true saturation and pulse rate of the input signals.

Display Update Interval

100 millisecond

Audible Indicators

Audible Indicator	Parameter	Value
Alarm Volume Setting	Volume level	Adjustable, 40 to 52 dB(A), at one meter
	Pitch (±30 Hz)	752 Hz
	On pulse width (±20 msec)	500 msec
	Off Interval (±20 msec)	10 msec
	Number of pulses in burst	1
	Repetition Pause (±2 sec.)	N/A
	Priority	1
Beep Volume setting	Volume level	Adjustable, 42 to 52 dB(A), at one meter
	Pitch (±30 Hz)	1500 Hz
	On pulse width (±20 msec)	500 msec
	Off Interval (±20 msec)	10 msec
	Number of pulses in burst	1
	Repetition Pause (±2 sec.)	N/A
	Priority	2
POST Pass	Volume level	Fixed at 45 dB(A), at one meter
	Pitch (±30 Hz)	600 Hz
	On pulse width (±20 msec)	1000 msec
	Off Interval (±20 msec)	10 msec
	Number of pulses in burst	1
	Repetition Pause (±2 sec.)	N/A
	Priority	3
Invalid Key Press	Volume level	Fixed at 45 dB(A), at one meter
	Pitch (±30 Hz)	200 Hz
	On pulse width (±20 msec)	50 msec
	Off Interval (±20 msec)	10 msec
	Number of pulses in burst	1
	Repetition Pause (±2 sec.)	N/A
	Priority	4

Audible Indicators (Continued)

Audible Indicator	Parameter	Value
Confirmation	Volume level	Fixed at 45 dB(A), at one meter
	Pitch (±30 Hz)	700 Hz
	On pulse width (±20 msec)	130 msec
	Off Interval (±20 msec)	130 msec
	Number of pulses in burst	3
	Repetition Pause (±2 sec.)	N/A
	Priority	5
Valid Key Press	Volume level	Fixed at 45 dB(A), at one meter
	Pitch (±30 Hz)	800 Hz
	On pulse width (±20 msec)	10 msec
	Off Interval (±20 msec)	10 msec
	Number of pulses in burst	1
	Repetition Pause (±2 sec.)	N/A
	Priority	6
Pulse Beep	Volume level	Adjustable, 42 to 52 dB(A), at one meter
	Pitch (±30 Hz)	1500 Hz
	On pulse width (±20 msec)	50 msec
	Off Interval (±20 msec)	10 msec
	Number of pulses in burst	1
	Repetition Pause (±2 sec.)	N/A
	Priority	7
Alarm Silence Reminder	Volume level	Adjustable, 42 to 52 dB(A), at one meter
	Pitch (±30 Hz)	500 Hz
	On pulse width (±20 msec)	130 msec
	Off Interval (±20 msec)	130 msec
	Number of pulses in burst	3
	Repetition Pause (±2 sec.)	179.27 sec.
	Priority	8

Audible Indicators (Continued)

Audible Indicator	Parameter	Value
High Priority Alarm	Volume level	Adjustable, 42 to 52 dB(A), at one meter
	Pitch (±30 Hz)	1200 Hz
	On pulse width (±20 msec)	250 msec
	Off Interval (±20 msec)	80 msec
	Number of pulses in burst	1
	Repetition Pause (±2 sec.)	0 sec.
	Priority	9
Medium Priority Alarm	Volume level	Adjustable, 42 to 52 dB(A), at one meter
	Pitch (±30 Hz)	752 Hz
	On pulse width (±20 msec)	400 msec
	Off Interval (±20 msec)	300 msec
	Number of pulses in burst	1
	Repetition Pause (±2 sec.)	0 sec.
	Priority	10
Low priority Alarm	Volume level	Adjustable, 42 to 52 dB(A), at one meter
	Pitch (±30 Hz)	500 Hz
	On pulse width (±20 msec)	400 msec
	Off Interval (±20 msec)	3200 msec
	Number of pulses in burst	1
	Repetition Pause (±2 sec.)	0 sec.
	Priority	11

Electrical

Batteries

Type	Voltage
4 AA alkaline	6 Volts DC (as per 4 AA batteries)

Battery life is typically:

- Alkaline 15 hours
- Lithium 40 hours

OxiMax Sensors

Wavelength	Nellcor pulse oximetry sensors contain LEDs that emit red light at a wavelength of approximately 660 nm and infrared light at a wavelength of approximately 900 nm. The total optical output power of the sensor LEDs is less than 15 mW. This information may be useful to clinicians, such as those performing photodynamic therapy. **Note:** Sensor LED light emissions fall within Class 1 level, according to IEC 60825-1:2001. No special safety precautions are required.

OxiMax Sensor Power Dissipation

Sensor	Dissipation
OxiMax MAX-N	52.5 mW
OxiMax MAX-I	52.5 mW
OxiMax MAX-P	52.5 mW
OxiMax MAX-A	52.5 mW
OxiMax MAX-AL	52.5 mW
OxiMax MAX-R	52.5 mW
OxiMax Durasensor DS-100A	52.5 mW
OxiMax OxiCliq® P	52.5 mW
OxiMax OxiCliq N	52.5 mW
OxiMax OxiCliq I	52.5 mW
OxiMax OxiCliq A	52.5 mW
OxiMax Dura-Y® D-YS	52.5 mW
OxiMax MAX-FAST	52.5 mW
OxiMax Softcare SC-PR	52.5 mW
OxiMax Softcare SC-NEO	52.5 mW
OxiMax Softcare SC-A	52.5 mW
OxiMax Oxiband OXI-A/N	52.5 mW

Environmental Conditions

Operation

Temperature	5 ºC to 40 ºC (41 ºF to 104 ºF)
Altitude	-390 m to 3,012 m (-1,254 ft. to 9,882 ft.)
Atmospheric Pressure	70 kPa to 106 kPa (20.6 in. Hg to 31.3 in. Hg)
Relative Humidity	15% to 95% non-condensing

Transport and Storage (not in shipping container)

Temperature	-20 ºC to 60 ºC (-4 ºF to 140 ºF)
Altitude	-390 m to 5,574 m (-1,280 ft. to 18,288 ft.)
Atmospheric Pressure	50 kPa to 106 kPa (14.7 in. Hg to 31.3 in. Hg)
Relative Humidity	15% to 95% non-condensing

Transport and Storage (in shipping container)

Temperature	-20 ºC to 70 ºC (-4 ºF to 158 ºF)
Altitude	-390 m to 5,574 m (-1,280 ft. to 18,288 ft.)
Atmospheric Pressure	50 kPa to 106 kPa (14.7 in. Hg to 31.3 in. Hg)
Relative Humidity	15% to 95% non-condensing

Physical Characteristics

Weight	0.62 lbs. (0.28 kg)
Dimensions	2.875 in. x 6.25 in. x 1.375 in. (7.3 cm x 15.9 cm x 3.5 cm)

Compliance

Item	Compliant With
Equipment classification	Safety Standards: EN 60601-1: 1990 (A1 + A2), EN 60601-1-2: 2001, UL 60601-1, CAN/CSA C22.2 No. 601.1
Type of protection	Internally powered equipment (on battery power)
Degree of protection	Type BF - Applied part
Mode of operation	Continuous
Front panel and case labeling	IEC 60878, EN 980, ISO 7000, EN 60417-1, EN 60417-2
Button spacing	ISO 7250
Year of manufacture symbol	EN 980
Operation during physical shock	IEC 60068-2-27 at 100 g
Alarm requirements	EN 60601-1-8
Pulse oximeters	EN 865 and ISO 9919 with Transport Boot (Part number 10007434)
Operation during vibration	IEC 60068-2-6 and IEC 60068-2-34
Radiated and conducted emissions	EN 55011, Group 1, Class B

Manufacturer's Declaration

WARNING: The use of accessories, sensors, and cables other than those specified may result in increased emission and/or create invalid readings of the *OXIMAX* N-65.

The *OxiMax* N-65 is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or user of the monitor can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the monitor as recommended below, according to the maximum output of the communications equipment.

Recommended Separation Distances between Portable and Mobile RF Communications Equipment and the *OxiMax* N-65 (IEC 60601-1-2)

Frequency of Transmitter	150 kHz to 80 MHz	80 MHz to 800 MHz	800 MHz to 2.5 GHz
Equation	$d = \left[\frac{3.5}{V_1}\right]\sqrt{P}$	$d = \left[\frac{3.5}{E_1}\right]\sqrt{P}$	$d = \left[\frac{7}{V_1}\right]\sqrt{P}$
Rated Maximum Output Power of Transmitter in Watts	Separation Distance in Meters	Separation Distance in Meters	Separation Distance in Meters
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23

For transmitters rated at a maximum output power not listed above, the separation distance can be estimated using the equation in the corresponding column, where P is the maximum output [power rating of the transmitter in watts (W)] according to the transmitter manufacturer.

Note: At 80 MHz to 800 MHz, the separation distance for the higher frequency range applies.

Note: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

Table 7: Electronic Emissions

The monitor is intended for use in the electromagnetic environment specified below. The customer or user of the monitor should assure that it is used in such an environment.

Emission Test	Compliance	Electromagnetic Environment - Guidance
RF emissions CISPR 11	Group 1	The monitor uses RF energy only for its internal function. Therefore, the RF emissions are very low and not likely to cause interference in nearby electronic equipment.
RF emissions CISPR 11	Class B	The monitor is suitable for use in establishments, including diagnostic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.

Table 8: Electromagnetic Immunity

The monitor is intended for use in the electromagnetic environment specified below. The customer or user of the monitor should assure that it is used in such an environment.

Immunity Test	IEC 60601 Test Level	Compliance Level	Electromagnetic Environment Guidance
Electrostatic Discharge (ESD) IEC 61000-4-2	± 6 kV contact ± 8 kV air	Complies	Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	± 2 kV power supply lines ± 1 kV for input/output lines	Complies	Main power should be that of a typical commercial or hospital environment.
Power Frequency (50/60 Hz) magnetic field	3 A/m	Complies	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz to 80 MHz	3 Vrms	Portable and mobile RF communications equipment should be used no closer to any part of the Monitor, including the cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter.
Radiated RF IEC 61000-4-3	3 V/m 80 MHz to 2.5 GHz	3 Vrms	
Recommended Separation Distance $d = \left[\frac{3.5}{V_1}\right]\sqrt{P}$			where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m).

Table 8: Electromagnetic Immunity (Continued)

The monitor is intended for use in the electromagnetic environment specified below. The customer or user of the monitor should assure that it is used in such an environment.

$d = \left[\frac{3.5}{E_1}\right]\sqrt{P}$	80 MHz to 800 MHz	Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey[a] , should be less than the compliance level in each frequency range.[b]
$d = \left[\frac{7}{V_1}\right]\sqrt{P}$	800 MHz to 2.5 GHz	

Interference may occur in the vicinity of equipment marked with this symbol.

Note 1: At 80 MHz, the higher frequency range applies.

Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

[a] Field strength from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in which the monitor is used exceeds the applicable RF compliance level above, the monitor should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the monitor.

[b] Over the frequency range 150 kHz to 80 MHz, field strength should be less than [V_1 } V/m.

Blank Page

Technical Discussion

Oximetry Overview

The *OxiMax* N-65 uses pulse oximetry to measure functional oxygen saturation in the blood. Pulse oximetry works by applying an *OxiMax* sensor to a pulsating arteriolar vascular bed, such as a finger or toe. The *OxiMax* sensor contains a dual light source and a photo detector.

Bone, tissue, pigmentation, and venous vessels normally absorb a constant amount of light over time. The arteriolar bed normally pulsates and absorbs variable amounts of light during the pulsations. The ratio of light absorbed is translated into a measurement of functional oxygen saturation (SpO_2).

Because a measurement of SpO_2 is dependent upon light from the *OxiMax* sensor, ambient light can interfere with this measurement.

Specific information about ambient conditions, *OxiMax* sensor application, and patient conditions is contained throughout this manual.

Pulse oximetry is based on two principles: that oxyhemoglobin and deoxyhemoglobin differ in their absorption of red and infrared light (i.e., spectrophotometry), and that the volume of arterial blood in tissue (and hence, light absorption by that blood) changes during the pulse (i.e., plethysmography). A pulse oximeter determines SpO_2 by passing red and infrared light into an arteriolar bed and measuring changes in light absorption during the pulsatile cycle. Red and infrared low-voltage light-emitting diodes (LED) in the oximetry *OxiMax* sensor serve as light sources; a photo diode serves as the photo detector.

Because oxyhemoglobin and deoxyhemoglobin differ in light absorption, the amount of red and infrared light absorbed by blood is related to hemoglobin oxygen saturation. To identify the oxygen saturation of arterial hemoglobin, the pulse oximeter uses the pulsatile nature of arterial flow. During systole, a new pulse of arterial blood enters the vascular bed, and blood volume and light absorption increase. During diastole, blood volume and light absorption reach their lowest point. The pulse oximeter bases its SpO_2 measurements on the difference between maximum and minimum absorption (i.e., measurements at systole and diastole). By doing so, it focuses on light absorption by pulsatile arterial blood, eliminating the effects of nonpulsatile absorbers such as tissue, bone, and venous blood.

Functional versus Fractional Saturation

This pulse oximeter measures functional saturation -- oxygenated hemoglobin expressed as a percentage of the hemoglobin that can transport oxygen. It does not detect significant amounts of dysfunctional hemoglobin, such as carboxyhemoglobin or methemoglobin. In contrast, hemoximeters such as the IL482 report fractional saturation -- oxygenated hemoglobin expressed as a percentage of all measured hemoglobin, including measured dysfunctional hemoglobins. To compare functional saturation measurements to those from an instrument that measures fractional saturation, fractional measurements must be converted as follows:

$$\text{functional saturation} = \frac{\text{fractional saturation}}{100 - (\%\,\text{carboxyhemoglobin} + \%\,\text{methemoglobin})} \times 100$$

Measured versus Calculated Saturation

When saturation is calculated from a blood gas partial pressure of oxygen (PO_2), the calculated value may differ from the SpO_2 measurement of a pulse oximeter. This usually occurs because the calculated saturation was not appropriately corrected for the effects of variables that shift the relationship between PO_2 and pH, temperature, the partial pressure of carbon dioxide (PCO_2), 2,3-DPG, and fetal hemoglobin. See Figure 25.

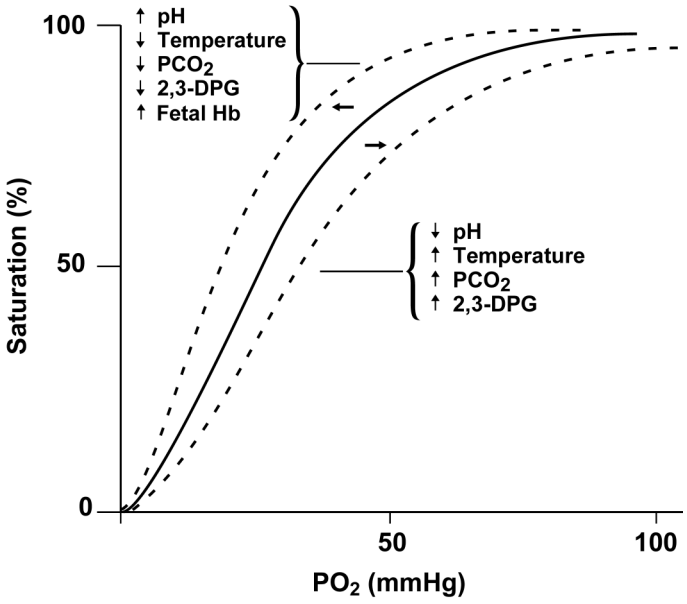


Figure 25: Oxyhemoglobin Dissociation Curve

OxiMax Technology

The monitor is designed to use Nellcor brand *OxiMax* sensors containing *OxiMax* technology. These *OxiMax* sensors can be identified by the deep blue color of their plug. All *OxiMax* sensors contain a memory chip carrying information about the *OxiMax* sensor which the monitor needs for correct operation, including the *OxiMax* sensor's calibration data, model type, troubleshooting codes, and error detection data. This unique oximetry architecture enables several new features with the monitor.

When an *OxiMax* sensor is connected to the monitor, the monitor first reads the information in the *OxiMax* sensor memory chip, checks it to make sure that there are no errors, and then loads the data to begin monitoring. As the monitor reads the information, it flashes the **Data In-Sensor** icon. This process takes a couple of seconds. Once the reading process is complete the monitor begins monitoring.

Pulse Oximeters containing *OxiMax* technology, including the monitor, use calibration data contained in the *OxiMax* sensor in calculating the patient's SpO_2.

Block Diagram Theory

This section provides an explanation of *OxiMax* N-65 block diagram theory of operation. Schematic diagrams and are provided at the end of this section.

The monitor consists of two printed circuit boards (PCB), the user interface PCB and the SpO2 PCB. The relationship between these two components and their interconnections is shown in the block diagram. See Figure 26.

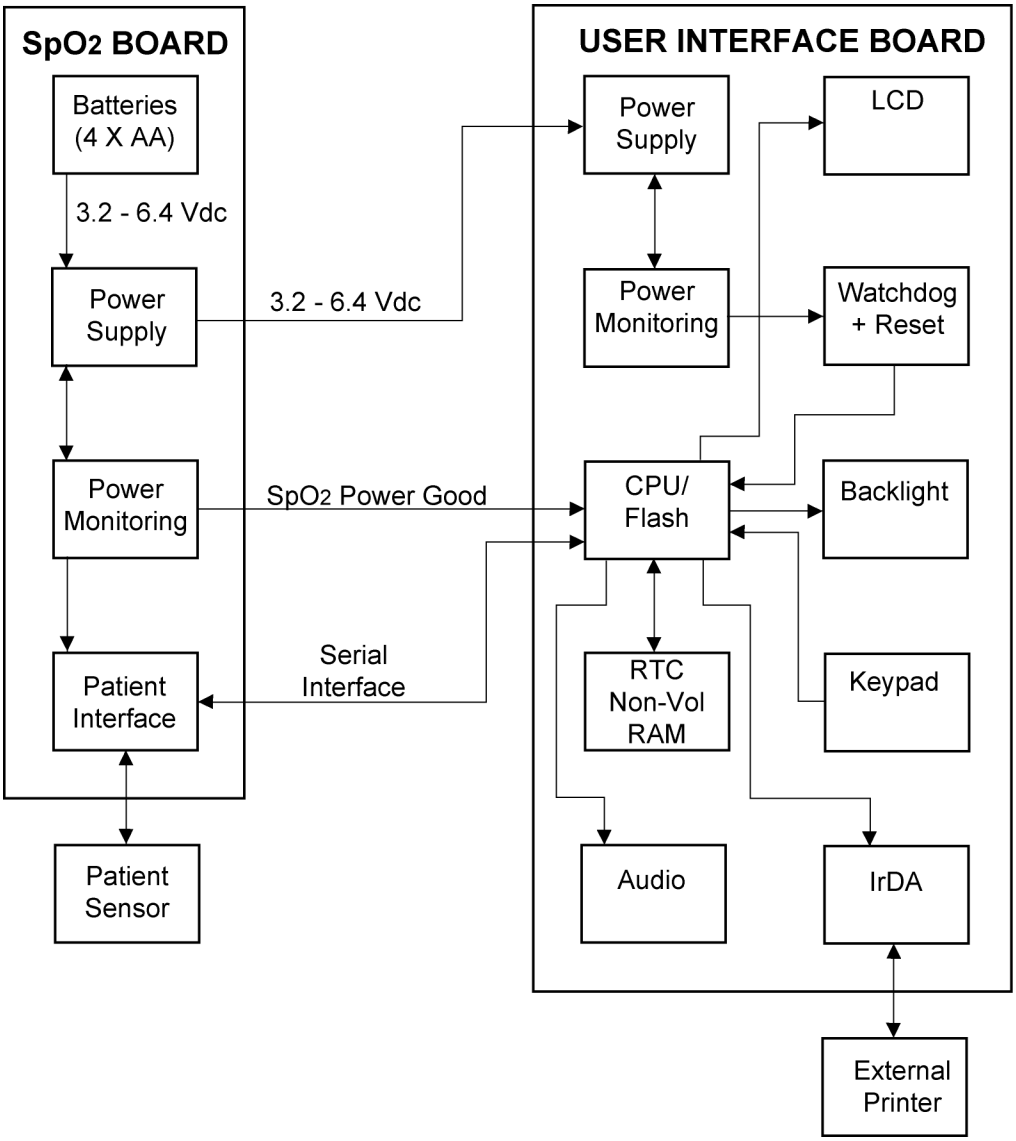


Figure 26: Block Diagram

SpO_2 Printed Circuit Board

The SpO_2 PCB provides patient interface and monitor operating power.

Patient Interface

The patient interface receives signals from the *OxiMax* sensor. These signal are converted and supplied to the user interface PCB central processing unit (CPU). The patient interface receives control signals from the CPU. These control signals are used to control the light emitting diodes in the *OxiMax* sensor.

Power Supply

The power supply provides operating voltages to the SpO_2 PCB and the user interface PCB. These voltages are supplied to the:

- SpO_2 PCB power monitoring function
- SpO_2 PCB circuits
- user interface PCB power supply
- user interface PCB CPU
- user interface PCB audio circuits

Power Monitoring

The SpO_2 power monitoring function monitors and controls the outputs of the SpO_2 power supply. The SpO_2 power monitoring function provides the user interface CPU and SpO_2 patient interface with status information on the power supply output signals.

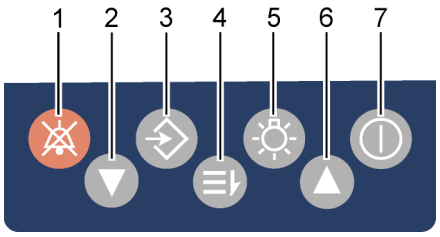
User Interface Printed Circuit Board

The user interface PCB provides:

- User setup of the monitor via the keypad
- Patient %SpO_2 and pulse rate via the display
- Monitor status via the display and audio function
- Printed reports via the IrDA (Infrared Data Association) and external printer
- Display readability in dark environments via the display backlight
- Operating voltages for the user interface circuits
- Operating voltage monitoring

Keypad

The user interface PCB keypad contains seven push buttons. These buttons allow the user to setup and control of the monitor. The buttons are:



1 — Alarm Silence	5 — Backlight
2 — Down Arrow	6 — Up Arrow
3 — Data	7 — Power
4 — Menu	

The signals from the buttons pass directly through the SpO_2 PCB and are applied to the user interface PCB CPU. The **Power** button signal is applied to the SpO_2 power supply turning the monitor on or off.

Backlight

The backlight illuminates the display for better viewing.

CPU and Flash

The CPU controls all functions and timing for the monitor. The CPU communicates with the SpO_2 PCB patient interface. The patient interface signal are sent to the CPU for processing. The CPU sends signals to the patient sensor via the patient interface for controlling the sensor light levels.

Real-Time Clock

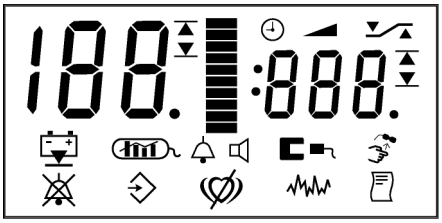
The real-time clock and non-volatile random access memory (RAM) chip maintain time and date used in the monitor. These circuits utilize a gold electrolytic super-capacitor for power when the monitor is turned off.

Audio

The audio circuit drives a transducer to provide the monitor tones.

LCD

The liquid crystal display (LCD) is driven by the CPU. The LCD displays the patient's %SpO_2 and pulse rate. The LCD also displays icons indicating the status and functions of the monitor. Refer to the *OXIMAX* N-65 Operator's Manual for a description of the icons.



IrDA

The IrDA (Infrared Data Association) is an industry standard for infrared communications. The IrDA receives information from the CPU, converts it, and sends it to an external printer. The external printer communicates with the IrDA. Refer to the printer manual for more information.

Power Supply

The user interface PCB power supply receives power from the SpO_2 PCB power supply. The power supply provides a regulated 3.0 volts DC to the CPU.

Power Supply Monitoring

The power supply outputs are monitored by the power monitoring function to ensure stability. The power supply monitoring circuit sends a reset signal to the watchdog circuits to shut down the monitor when voltages are out of tolerance.

The power supply monitoring circuit monitors the battery output voltage and shuts down the monitor when the battery voltage is critically low. The circuit provides the low battery signal.

Blank Page

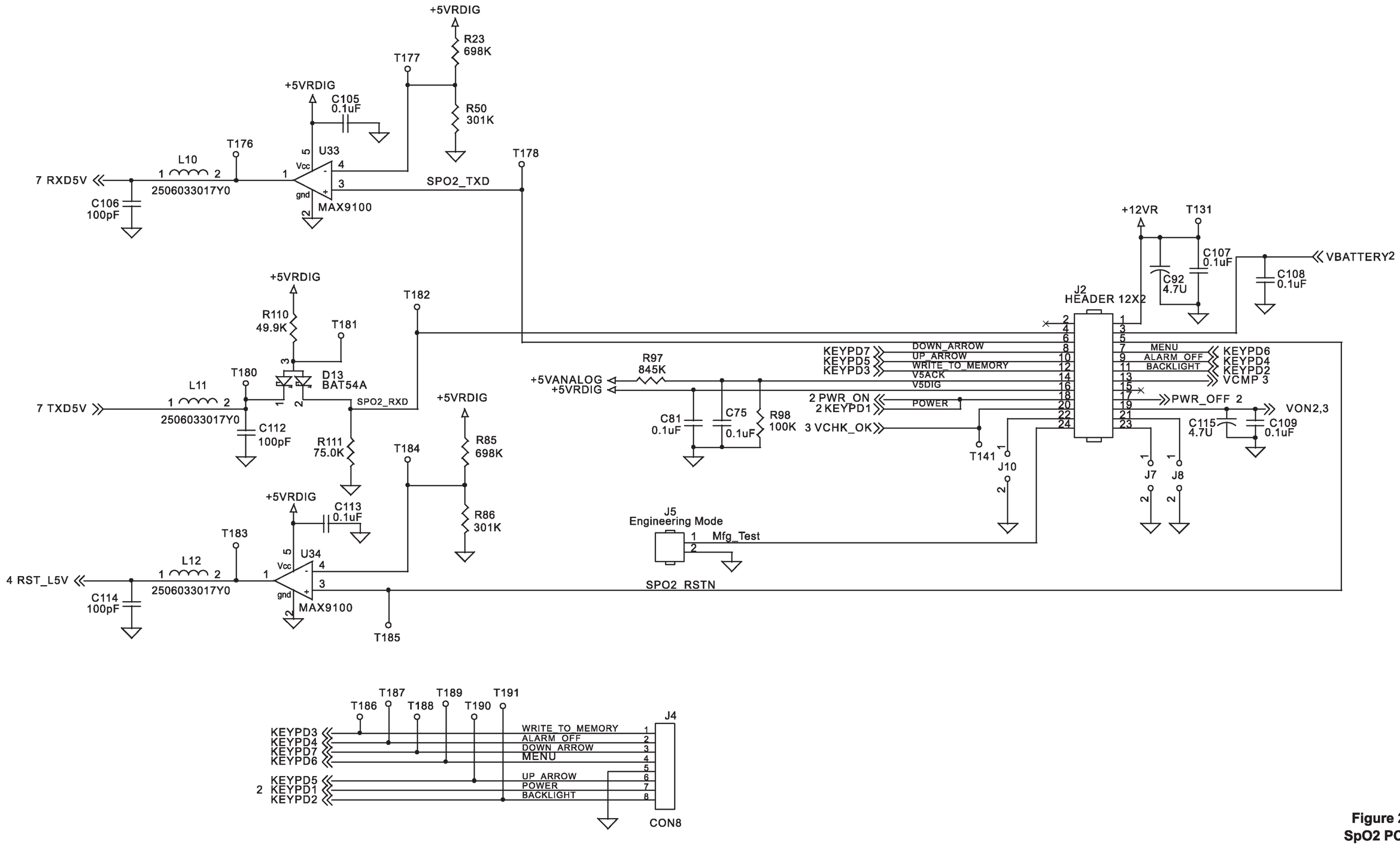


Figure 27
SpO2 PCB
Schematic Diagram
(sheet 1 of 7)

Blank Page

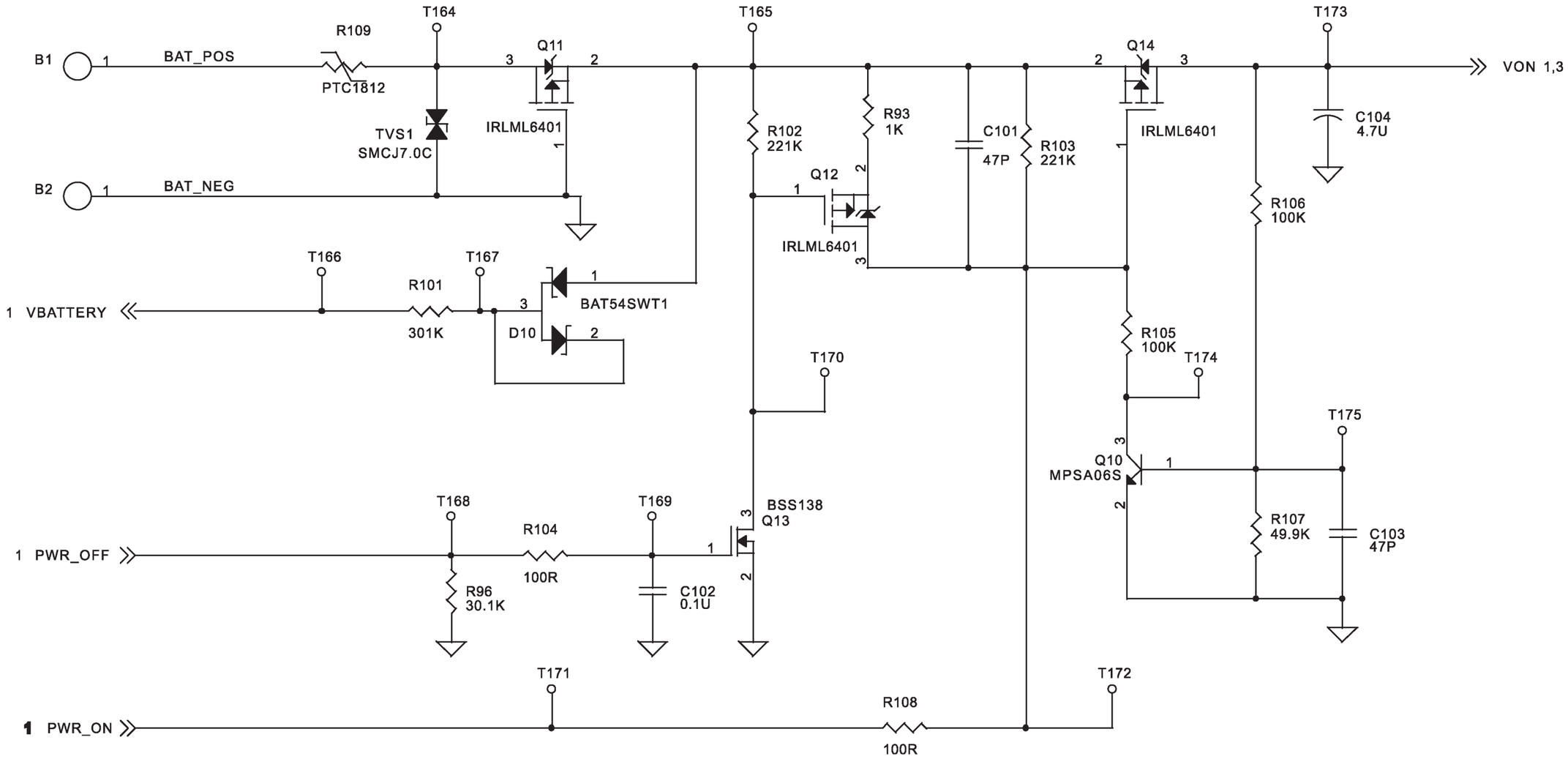
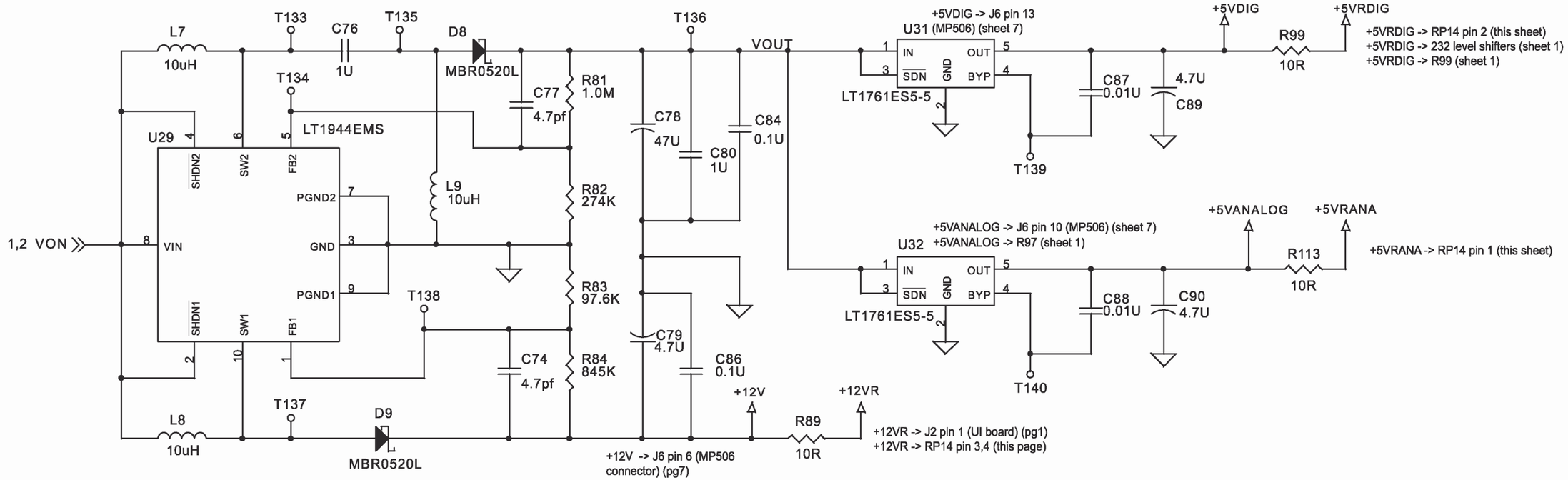


Figure 28
SpO2 PCB
Schematic Diagram
(Sheet 2 of 7)

Blank Page



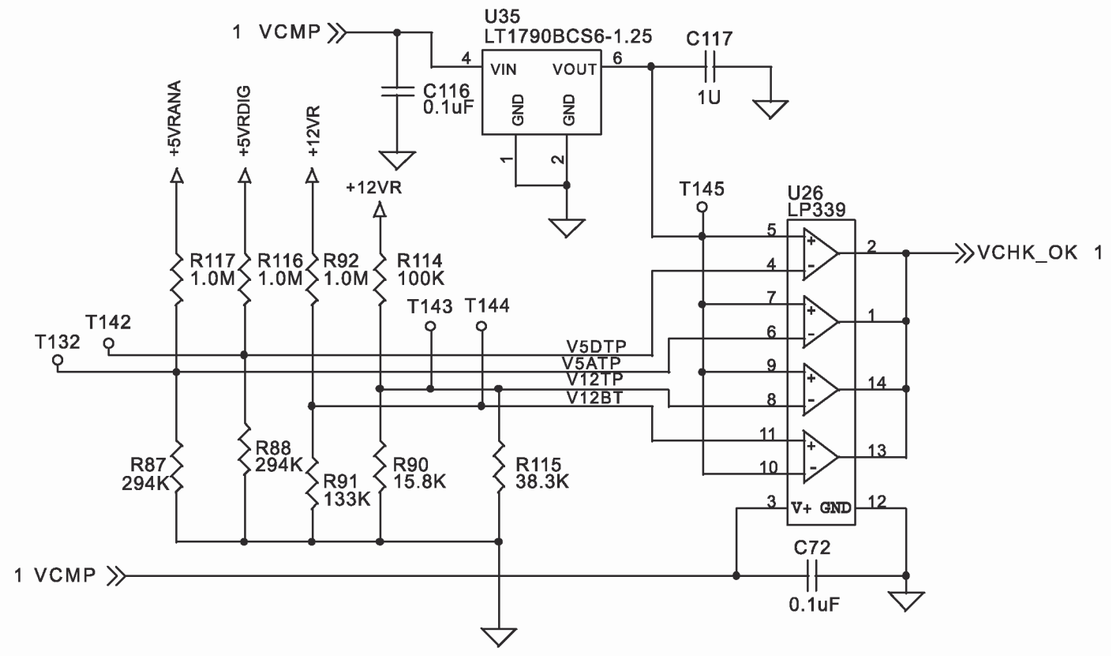
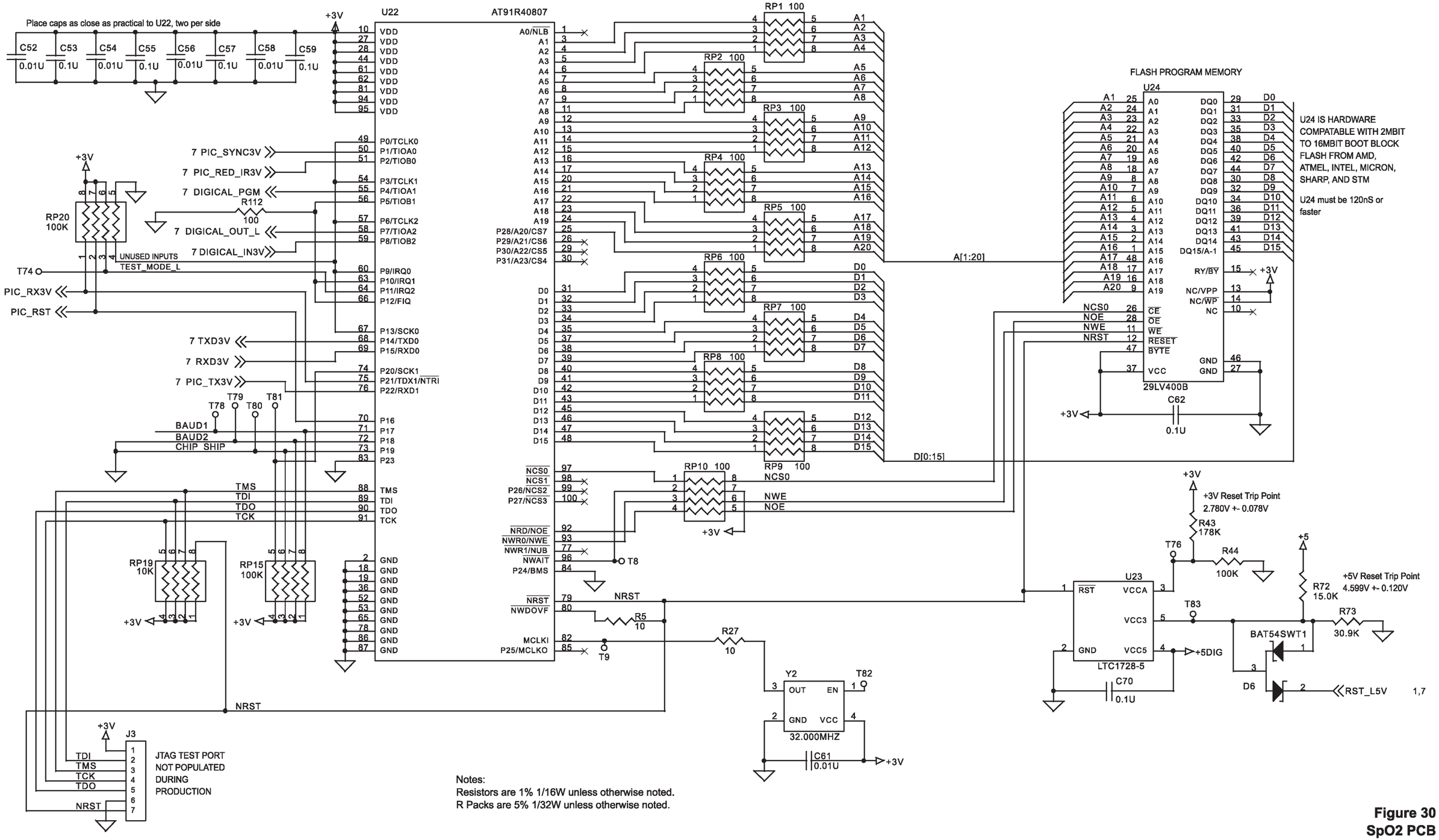


Figure 29
SpO2 PCB
Schematic Diagram
(Sheet 3 of 7)

Blank Page



Notes:
Resistors are 1% 1/16W unless otherwise noted.
R Packs are 5% 1/32W unless otherwise noted.

Figure 30
SpO2 PCB
Schematic Diagram
(Sheet 4 of 7)

Blank Page

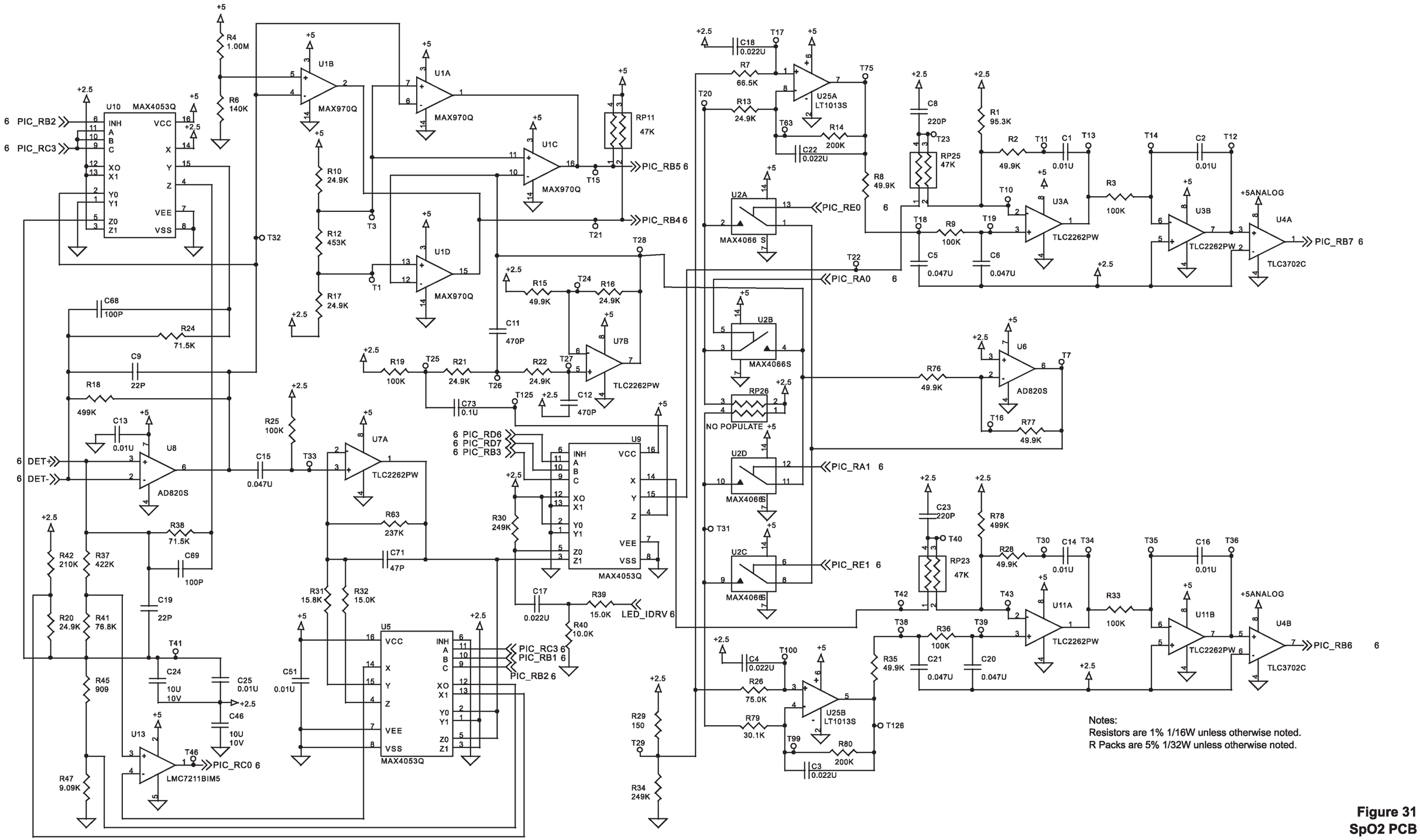


Figure 31
SpO2 PCB
Schematic Diagram
(Sheet 5 of 7)

Blank Page

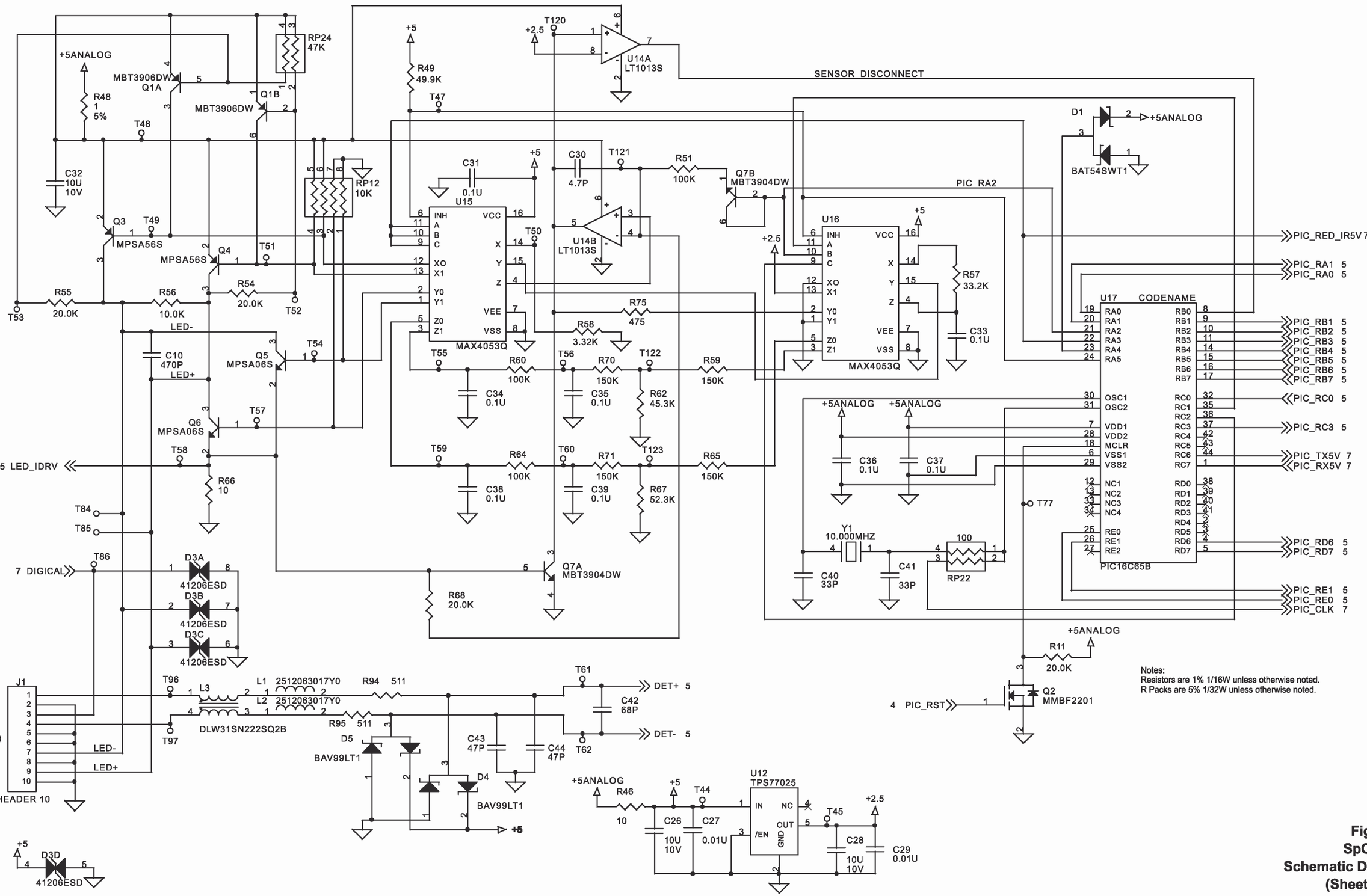


Figure 32
SpO2 PCB
Schematic Diagram
(Sheet 6 of 7)

Blank Page

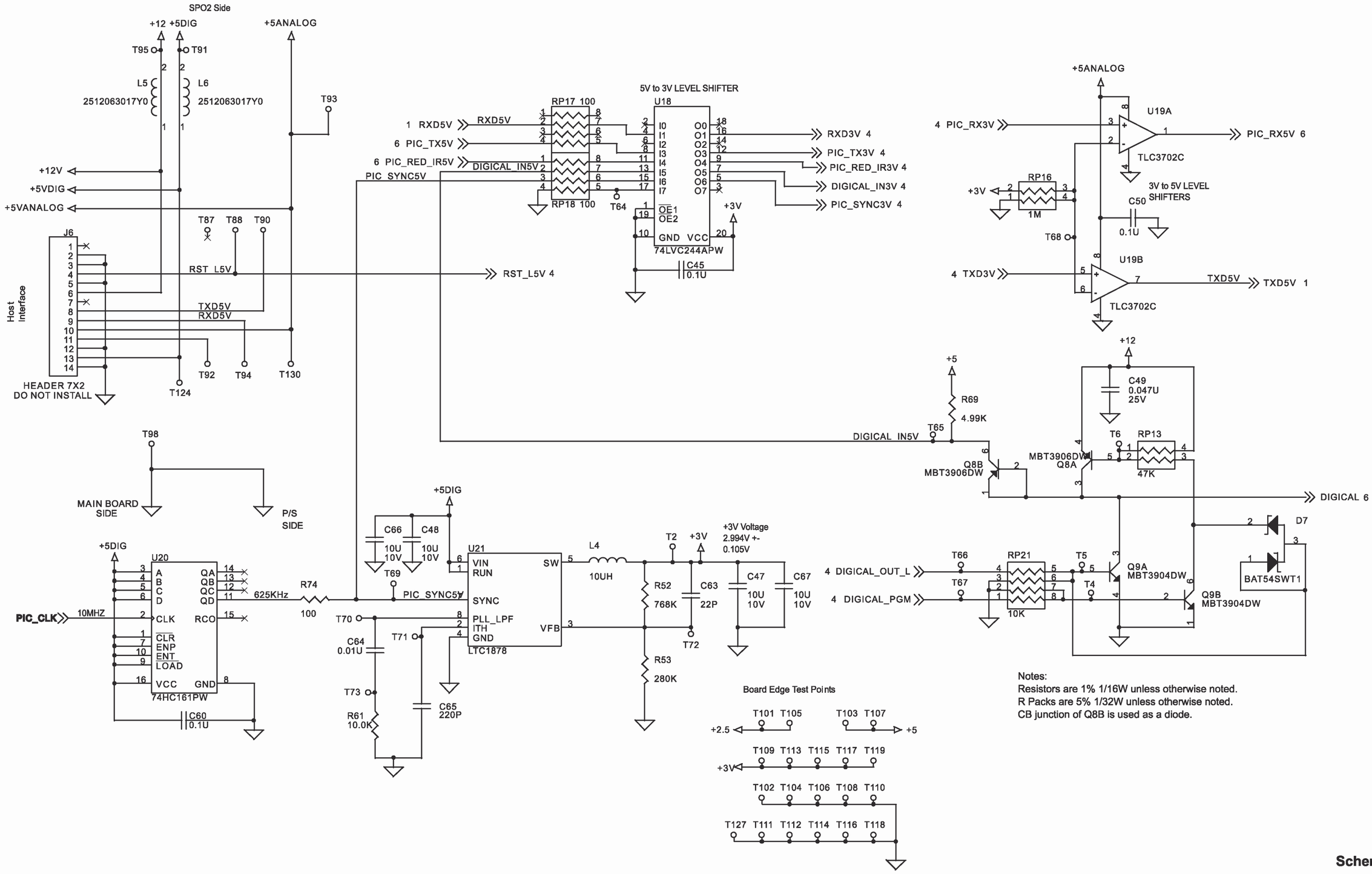


Figure 33
SpO2 PCB
Schematic Diagram
(Sheet 7 of 7)

Blank Page

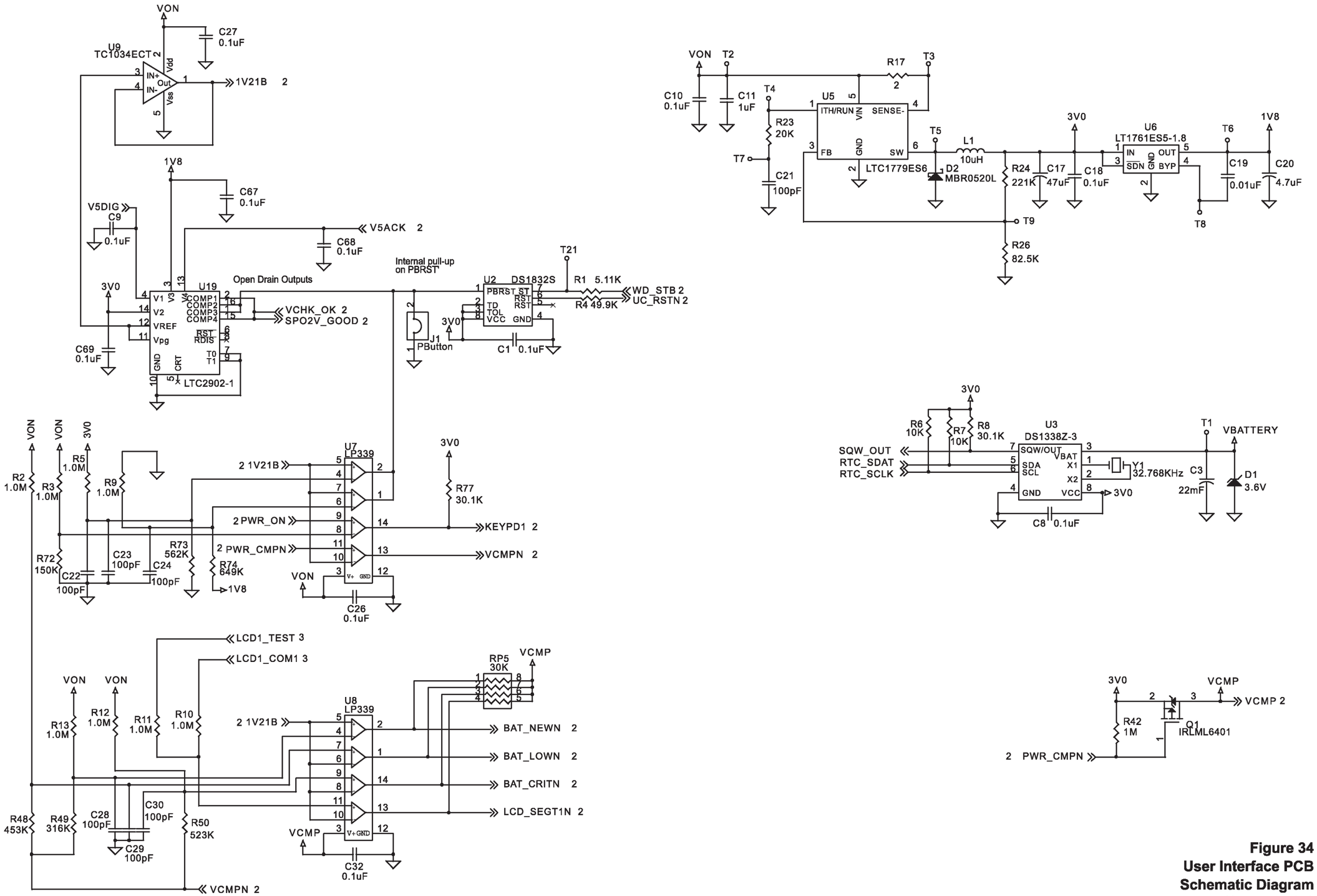


Figure 34
User Interface PCB
Schematic Diagram
(Sheet 1 of 3)

Blank Page

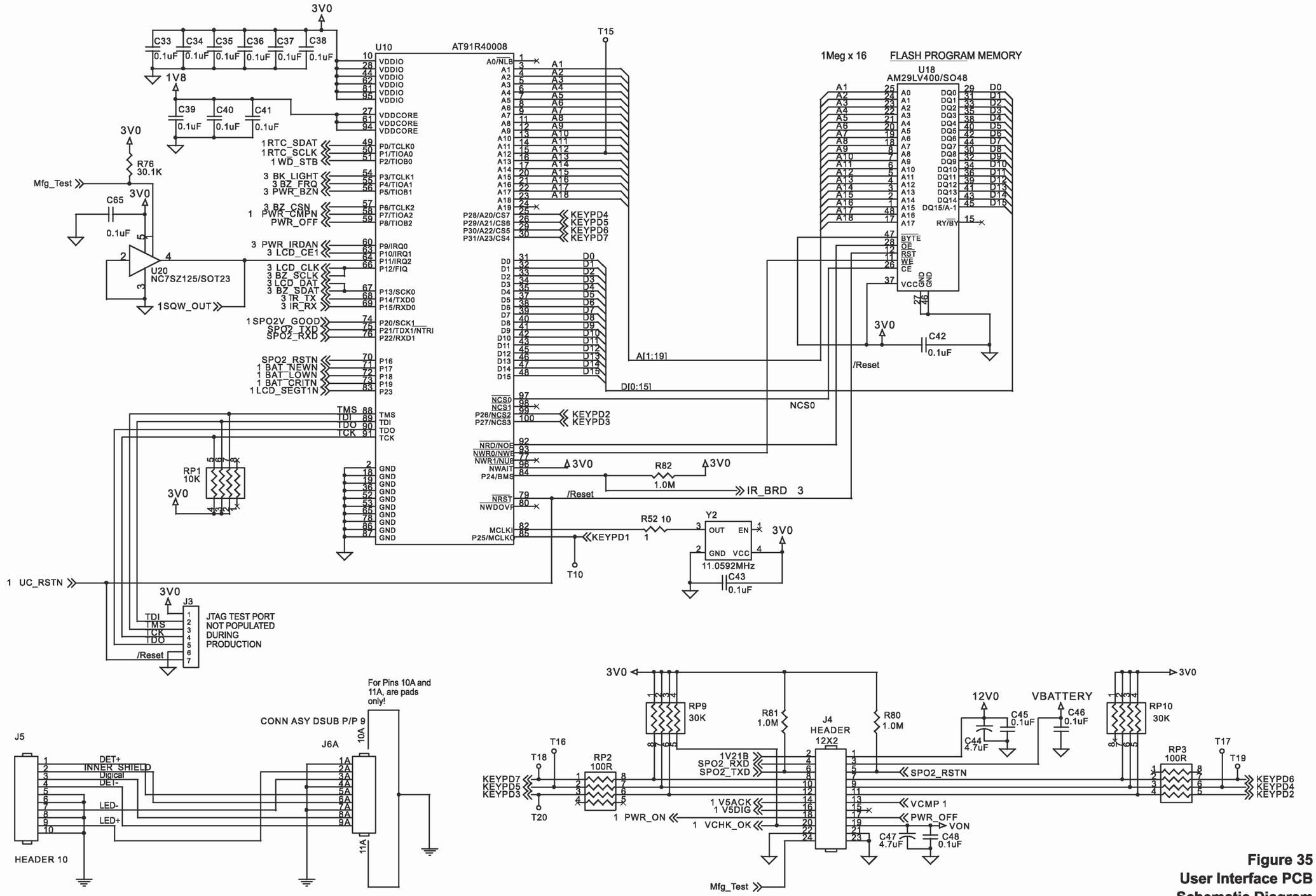
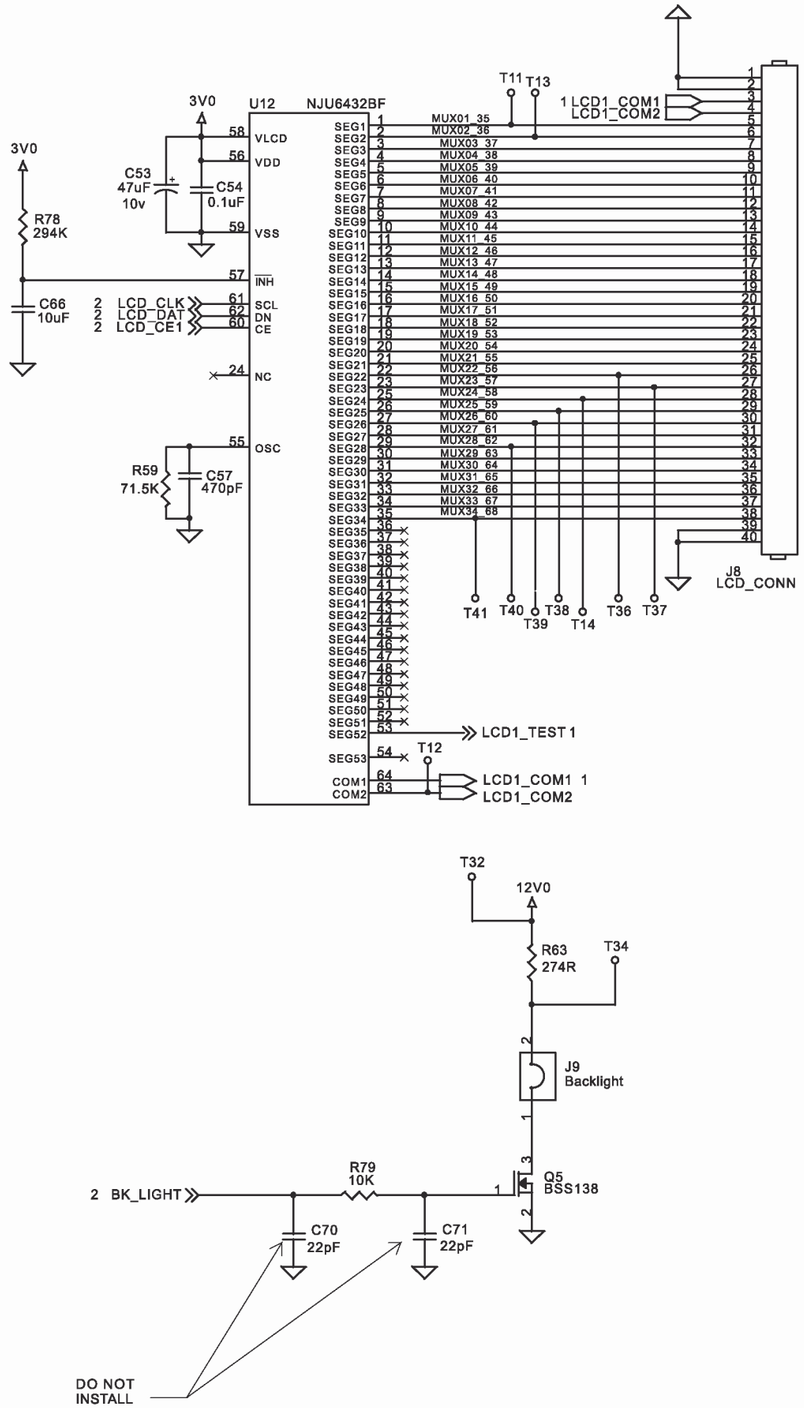
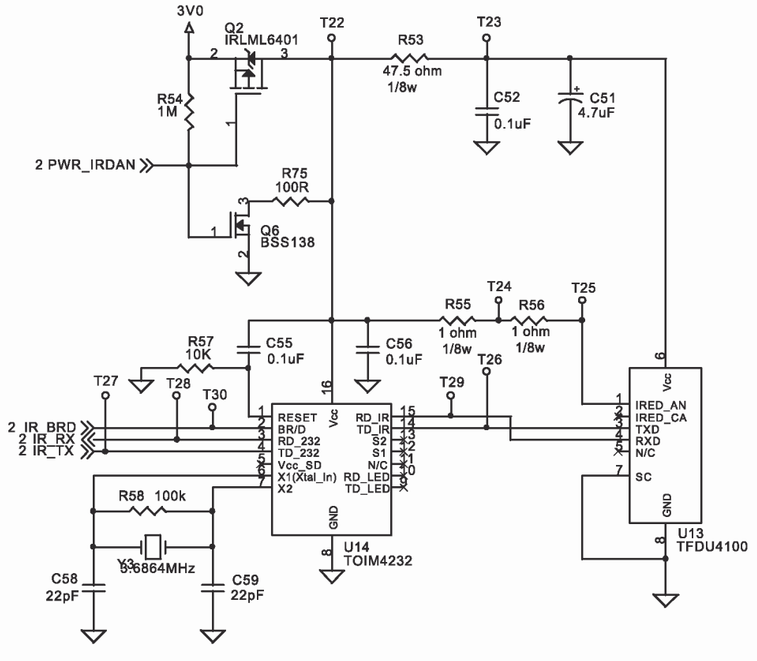


Figure 35
User Interface PCB
Schematic Diagram
(Sheet 2 of 3)

Blank Page





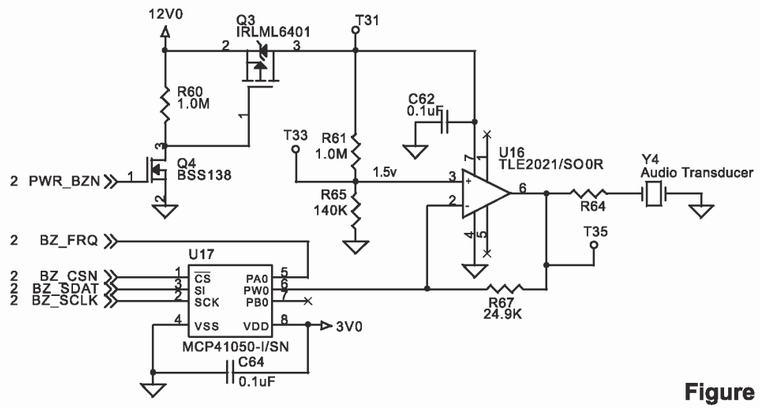


Figure 36
User Interface PCB
Schematic Diagram
(Sheet 3 of 3)

Blank Page

Index

Symbols

%SpO2 high limit 11
%SpO2 low limit 11

A

accessories on internet 14
accuracy 69
alarm volume 11
arterial dyes 17
audible indicator 70

B

battery compartment door replacement 59
battery installation 16
block diagram theory 84
bpm high limit 11
bpm low limit 11
business reply card 47

C

calculated saturation 82
calibration 15
cautions 2
cleaning 15

D

date and time 22
day 13
description of OxiMax N-65 4
disassembly guide 47
disinfecting 15
display update interval 69
DS-100A 17
dysfunctional hemoglobin 17

E

equipment needed for performance checks 17
error codes 42
exploded view 63
explosion hazard 1
extension cable 17
external agents 17

F

fractional saturation 82
front case assembly replacement 54
front panel description 4
front panel symbols 8
function menu 10
functional checks 15
functional saturation 82
functional tests 28

H

hour 13

L

label symbols 9
low perfusion 17

M

manufacturer's declaration 75
measured saturation 82
medical procedures 17
menu
    set time and date 12
minute 13
monitor
    measurement range 69
    returning the monitor 65
month 13

N

nitrous oxide 16

O

obtaining replacement parts 61
obtaining spare parts 61
operating
    altitude 74
    relative humidity 74
    temperature 74
operation with a live subject 26
operational setup 22

operator's manual 14
OXIMAX technology 83
oximetry overview 81

P

packing for shipment 65
packing in a different carton 67
parts list 61
performance verification 17
periodic safety checks 15
physiological conditions 17
POST pass tone 20
power-on self-test 17
print data 11
pulse beep volume 11

R

rear case assembly replacement 57
rear panel symbols 8
related documents 14
repacking in original carton 65
replacement
  battery compartment door 59
  front case assembly 54
  rear case assembly 57
  user interface pcb 50
replacement level supported 47
Returned Goods Authorization (RGA) number 65
RGA number 65
routine maintenance 15

S

safety tests 37
sensors 73
separating the front and back cases 48
service manual 14
spare parts 61
spare parts on internet 14
specifications 69
  battery 73
  compliance 75
  electrical 73
  environmental 74
  performance 69
  physical 75
SRC-MAX 28
SRC-MAX tester 17
storage
  altitude 74
  relative humidity 74
  temperature 74
strangulation 2
surface-cleaning 15
symbols
  Canadian ICES-001 approval 9
  date of manufacture 9
  European union approval 9
  fragile 9
  keep away from heat 9
  keep upright 9
  label 9
  protect from moisture 9
  rear panel 8
  resistant to liquid ingress 8
  Russian regulatory approval 9
  see instructions for use 8
  serial number 9
  temperature limitation 9
  type BF applied part 8

T

technical discussion 81
test #1
  SpO2 33
test #2
  bpm 32
test #3
  modulation level 34
test #4
  light level 36
time set menu 13
transport
  altitude 74
  relative humidity 74
  temperature 74
troubleshooting guide 39

V

verify performance 17

W

wavelength 73
wavelength, sensor 73
who should perform repairs 39

Y

year 13

NELLCOR

Tyco Healthcare Group LP
Nellcor Puritan Bennett Division
4280 Hacienda Drive
Pleasanton, CA 94588 U.S.A.
Telephone 1.800.635.5267

Authorized Representative
Tyco Healthcare UK LTD
154 Fareham Road
Gosport PO13 0AS, U.K.

© 2006 Nellcor Puritan Bennett Inc.
All rights reserved.

Rx ONLY

CE
0123

tyco
Healthcare

10006573C-0306